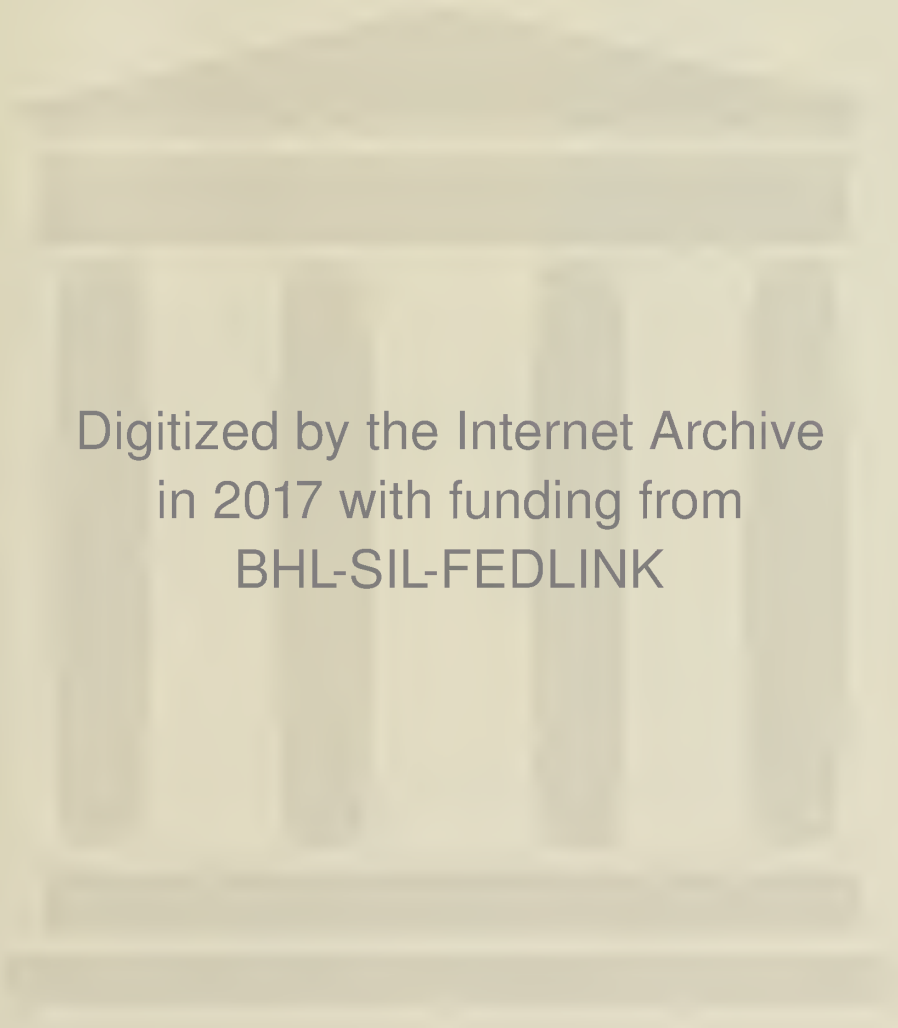

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Cover: Lombardy poplars (*Populus nigra* 'Italica') at Sceaux, France. Photograph by Marc Treib.

Inside front cover: Newly planted trees in the Tercentenary Theater of Harvard Yard. Photograph by Karen Madsen.

Inside back cover: Lombardy poplars in Chile. From the Archives of the Arnold Arboretum.

Populus nigra 'Italica'

The next generation of trees for Harvard Yard (Peter Del Tredici).

Restoring the Harvard Yard Landscape

Michael Van Valkenburgh and Peter Del Tredici

The spirit of Harvard Yard resides in its canopy of trees, tall, reaching groves that define spaces and passageways and create an evocative sense of place.

Simplicity and understatement are the prevailing qualities of Harvard Yard's landscape, the result of a New England aesthetic that might also be termed frugal elegance. It is an almost completely built artifice that has evolved over more than three centuries of intervention and transformation. As a composition, the landscape and the buildings within Harvard Yard are inseparable. Yet it is the landscape—a simple order composed of a continuous ground plane of grass crossed with paths—that has retained the more enduring, timeless character. The lawn establishes a base on which a broad range of building types in various styles are sited. Overhead a high canopy of deciduous trees completes this majestic landscape. Combined, the lawn and the canopy unify the spaces of the Yard and engender a unique sense of place.

The maturity of the tree canopy and the imminent loss of most of the American elms have become pressing concerns. A nearly catastrophic number of trees were felled during the last two decades. Many of these were elms that were infected with the Dutch elm disease, but many others succumbed to stresses common to the urban landscape: soil compaction, root damage effected during construction projects, salt used for ice melting, and fluctuations in the water table. Still other trees were lost due to damage in the snow and ice storms of the late 1970s and early 1980s.

Despite the continual buzz of chainsaws in the Yard over the past two decades, few new trees have been planted. As a result, Harvard now needs to make up for lost time. Almost two hundred trees at semi-mature sizes must be planted throughout the larger Harvard Yard area to recreate the presence of the grove. Because trees grow slowly, the need to replant the Yard's canopy has become urgent. In 1991 the University undertook a study of the series of large and small spaces that constitute Harvard Yard, broadly defined as the Old Yard, the Tercentenary Theater, Seaver Quad, the Science Center Overpass and Memorial Hall, Quincy and Prescott Streets. As a first step, an ad hoc tree committee was convened.* The product of this group's effort, a list of trees suitable for Harvard Yard, can be seen below. Sixty-eight trees have been planted this spring. Another six will be added this fall and two more next spring.

The New Tree Canopy

The predominating American elms *(Ulmus americana)* have imprinted themselves on all who are familiar with the Yard. As a species, the elm is fast growing, readily available, easy to transplant in large sizes; and highly tolerant of compacted soils. Its natural form provides a tall, high-branched canopy. Understandably, it was a favorite of our predecessors, but its fate strongly suggests that replanting not be domi-

* Bernard Keohan, Robert Lyng, Robert Mortimer, Peter Del Tredici, Michael Van Valkenburgh, and Tim Barner.

nated by a single species of trees, which might again leave the Yard vulnerable to the devastating effect of insects and diseases. All replacements must be well suited to stressful urban growing conditions, and in the interests of a unified composition, trees with odd colored bark, flowers, or leaves should be excluded since they would not blend with other species.

To recreate a canopy reminiscent of the character of the American elms—to retain not only their memorable quality but also unimpeded views across the Yard—each of the main spaces should be planted with a careful blend of two, three, or four tree species. In combining trees the visual character of each species in every season of the year must be considered: the overall form and color when the tree loses its leaves in the autumn; leaf color in spring, summer, and fall; any significant flowers or fruit. The committee left open the possibility that occasionally an additional, single species may be added, or preserved, if it is an existing tree in good health. For example, the few remaining white pines *(Pinus strobus)* should remain as effective counterpoints to the new canopy. Indeed, a new white pine will be planted this fall, along with a catalpa *(Catalpa speciosa)* and a horse chestnut *(Aesculus hippocastanum)*, not so much for canopy replacement but to help reinforce the existing specimens of the same species.

In replicating the character of the American elm grove, which retained few branches below twenty feet above ground level, it must be remembered that once a tree grows a branch, the height of that branch does not change with later growth. For this reason, high-branched specimens have been planted from the inception of the Yard's new grove. Trees grown with lower branches removed to six or seven feet above ground constitutes the minimum standard for transplanting into Harvard Yard. At the time of planting, additional low branches have been removed to a height of eight or nine feet above ground level. Branches should always be removed when they are quite small, as the larger cuts resulting from the removal of more mature branches require more time to heal. Over the next twenty years, additional branches will be removed gradually as each tree increases in height.

The recommended transplant size for new trees in Harvard Yard is five or six inches in diameter at six inches above the ground; this is typically a tree about twenty to twenty-eight feet tall. Re-training the form of the trees requires careful selection of specimens with good structural development and a strong central leader, rather than trees with several leaders.

Many of the species on the tree committee's list, including the Japanese pagoda tree *(Sophora japonica)* and red oak *(Quercus rubra)*, lend themselves, with attentive maintenance, to a high-branched and elmlike form even though their natural character, when grown in an open location, is a low-branched and rounded form. A lightly shaded growing environment where there is competition for sunlight alters the growth habit of a tree and yields a reaching elmlike character. New trees, if carefully located in the light shade of other trees in the Yard, are encouraged to grow taller as they reach for the sunlight above. New trees have not been planted directly under existing trees, but rather outside their drip line.

Within Harvard Yard there are numerous microclimates that affect tree growth. In selecting species, the nuances of each planting site have been carefully considered, with particular attention to soil type, drainage, wind, available sunlight and shade, soil moisture content created by variable drainage conditions, density of traffic, and extent of pavement coverage, which increases soil temperatures in the root zone in summer. Also considered was the proximity of new trees to existing large trees, which create root competition and shade that affect their development.

The tree committee recommended that all trees in poor condition be removed between 1993 and 1994. Trees rated in fair condition may have several years of life remaining and will not be removed—except for design rea-

Newly planted canopy trees in the Old Yard (Karen Madsen).

sons—until they decline further. In some instances trees in fair condition remain on our plan; these are especially venerable trees that, with special care and attention, may survive for many years.

Old Yard

To many, the Old Yard is Harvard Yard. It is the largest and oldest space, with generous proportions and a commanding presence. Its perimeter of enclosing buildings, which define the sides of the space, is perceptively simple but spatially sophisticated. Through time the placement of buildings has foiled what otherwise would be an unrelenting length spanning the two long sides of the Yard (750 feet), yielding instead stepped and ambiguous alignments. In contrast, the short ends of the Old Yard (250 feet) are completed with single buildings. The stepped sides coupled with the stolid ends create an impressive volume that, when filled with trees, establishes an aura of calm power.

The spirit of the Old Yard is largely attributable to its enveloping canopy of majestic deciduous trees, which create an embracing grove. While this grove has been dominated by the American elm for most of the twentieth century, other species have been included to produce a more complex composition. The form of these other trees, most notably red oak and honey locust, has been managed to make them more elmlike in character. Branches have been removed for the first eighteen to twenty feet of each tree.

In the Old Yard, we have planted a mix of honey locust *(Gleditsia triacanthos)*, Japanese pagoda tree *(Sophora japonica)*, red oak *(Quercus rubra)*, scarlet oak *(Quercus coccinea)*, and willow oak *(Quercus phellos)*. The trees have been planted in four existing north–south rows with spacing irregular within the rows. A fifth row has been re-established in front of the west

The tree canopy in the Tercentenary Theater is reinforced with new plantings installed by Hartney/Greymont, Inc., of Needham, MA (Karen Madsen).

side of Thayer and Weld Halls. Red oaks were used in front of Thayer and scarlet oaks in front of Weld.

Two rows of tulip poplar trees *(Liriodendron tulipifera)* form an allée to frame the statue of John Harvard. These rows start at the Johnston Gate and are embedded in the existing grove of the Old Yard. Hackberries *(Celtis* x 'Magnifica') have been planted west of the Johnston Gate, at the site opened up by the removal of the existing yews at the gate. These two trees, with their elmlike shape, take the place of two downed elms.

Tercentenary Theater

The Tercentenary Theater is the heart of Harvard Yard and one of the major time-honored landscape spaces. The enclosure of the Tercentenary Theater was completed by Memorial Church in the 1930s. The symmetry of Widener Library and Memorial Church and the commanding nature of their broad bands of stairs create a space that has became the symbolic center of the Yard. It is its geographic center as well and is the most important ceremonial space on campus, where people from the entire university gather for graduation and other celebratory events.

The character of the grove of trees planted in the rectangular space further compliments the ceremonial quality of the Tercentenary Theater. In contrast to the darker oaks and maples at the periphery of the space, honey locusts *(Gleditsia triacanthos)*, with their fine textured foliage, allow dappled light to permeate the center ground of the space and to form a halo of light in the middle. Additional honey locust trees have been planted to supplement the existing ones. Red maples *(Acer rubrum)* have been planted as a rectangular perimeter

around the irregular placement of the honey locusts. This patterning will not be apparent until the autumn when the yellows of the honey locusts will be framed by the spectacular scarlet foliage of the red maples. Yellowwoods *(Cladrastis kentuckea),* which bloom at commencement time, have been planted irregularly at the periphery of the space. Three Kentucky coffee trees *(Gymnocladus dioicus)* and two bur oaks *(Quercus macrocarpa)* were planted on the lawn west and north of Widener Library. The three legumes share a characteristic flat-topped crown, and although clearly distinct from one another, have similar enough forms to create a sense of harmony. It is essential that all trees planted in the Tercentenary Theater be limbed up from the bottom as they grow, to allow unobstructed views throughout the landscape.

The new trees will appear young for ten to fifteen years, and then although they will still be quite small, they will begin to blend with the remaining large trees. Eventually two hundred-plus trees are to be planted; there are approximately three-hundred-thirty existing trees within the perimeter of the Yard Fence.

The Tree List

Following is the final list of tree species selected for planting in the Yard. The tree committee gave careful consideration to overall visual character, leaf density, color, scale, and form. The list is intended to provide the landscape architect with flexibility in dealing with the unpredictable issues of size and availability that inevitably complicate any landscape job.

The list of canopy trees focuses on species with a strong tendency to form a tall, straight trunk and a broad, spreading crown in a relatively short time. Species marked with an asterisk (*) are considered secondary choices insofar as they possess some characteristic that causes maintenance problems; are slow-growing; are difficult to transplant; or hard to locate in nurseries. The decision to use these secondary species should be based on finding the right location for them as well as the size and quality of specimens available from nurseries. Tree species suitable for the periphery of the Yard are presented in Part II.

PART I: CANOPY TREES

***Acer rubrum* (Red Maple)**

This midsized tree produces great spring and fall color and is tolerant of compacted soil conditions. Red maple will perform well in the Yard and will add interest in the fall, a feature that is currently lacking.

***Acer saccharum** (Sugar Maple)**

This tree has beautiful fall color but is intolerant of compacted soil and road salt. It has a roundheaded crown and casts a dense shade. In the Yard it will need to be carefully sited away from areas with heavy pedestrian or vehicular traffic.

***Celtis laevigata** (Sugarberry)**

This species, which is very tolerant of compacted soils, is well worth trying in the Yard although specimens may be difficult to find. It is larger and more robust than the common hackberry, ***Celtis occidentalis,*** and can be quite elm-like in its form.

***Gleditsia triacanthos* var. *inermis* (Thornless Honey Locust)**

Because of its graceful form, the honey locust is the tree that many horticulturists view as the ideal replacement tree for the American elm. We should be cautious not to overuse the tree as was done with the American elm, given that it is susceptible to a number of serious diseases. The fact that grass grows well under the light canopy of the honey locust makes it an excellent choice. Using male selections will reduce the litter problem posed by seed pods.

***Gymnocladus dioicus** (Kentucky Coffee Tree)**

Kentucky coffee tree, while it has a very sparse growth habit and stark winter outline, is a strikingly beautiful tree. Like the honey locust it casts a light, delicate shade that allows grass to prosper. Male selections should be planted if possible.

Liriodendron tulipifera **(Tulip Poplar Tree)**
Tulip poplar tree has an upright growth habit and very beautiful flowers and leaves. It grows extremely large, so should be planted only in larger spaces. It forms a tall, straight trunk and has good yellow fall color.

Magnolia acuminata* **(Cucumber Tree)**
Cucumber magnolia is a very stately single-trunked tree that could be used sparingly in the Yard. It does not appear to have any disease problems, but its large leaves might be seen as a litter problem in the fall.

Quercus bicolor **(Swamp White Oak)**
Swamp white oak would be a great addition to the Yard if large specimens can be located. It is slow to establish itself, but well worth the wait. The white oak, ***Quercus alba,*** is equally acceptable from a landscape point of view but considered more difficult to transplant.

Quercus coccinea **(Scarlet Oak)**
Scarlet oak is similar to pin oak in habit and leaf shape but is somewhat slower growing and more difficult to transplant. It does, however, have much better fall color than pin oak. ***Quercus shumardi,*** the Shumard red oak, is similar in many respects to the scarlet oak, and some growers consider it a better performer.

Quercus palustris **(Pin Oak)**
Pin oak casts a lighter shade than red oak and needs to be limbed up in order to see its beautiful, smooth trunk. It is tolerant of both poorly drained and compacted soils. When young, this species tends to hold its brown leaves throughout the winter. This problem can be overcome by selecting trees in the nursery that have outgrown this "juvenile" trait.

Quercus phellos* **(Willow Oak)**
The narrow, willowy leaves of this beautiful tree cast a light shade. It is relatively easy to transplant and tolerant of wet, compacted soil. A common street tree in the south, the species has traditionally been considered marginally hardy in the Boston area. However, experience indicates that trees from the northern parts of its range (central New Jersey) are hardier than plants from more southern areas. If northern trees can be located in a nursery, willow oak would make a nice addition to the Yard.

The shadow of an American elm falls on Stoughton Hall in the Old Yard (Peter Del Tredici).

Quercus rubra **(Red Oak)**
Red oaks are already abundant in the yard, but a few more could well be planted. Because it casts a dense shade, trees of this species should not be planted too closely together or the grass will suffer. Many other tall oaks, including ***Q. acutissima, imbricaria,*** and ***macrocarpa,*** would perform well in the Yard, and their use is limited only by their availability.

Sophora japonica* **(Japanese Pagoda Tree)**
The Japanese pagoda tree is a beautiful alternative to the honey locust. It does, however, have a tendency to retain its lower branches. For this reason, tall specimens that had been limbed up in the nursery should be specified for planting in the Yard.

PART II: PERIPHERY TREES

These are species suitable for special purposes. In general, they are somewhat smaller in stature than the canopy trees listed above; have a narrow as opposed to a spreading growth habit; or show a pronounced tendency to retain their lower limbs. They should be used near buildings or around the edges of the Yard to lower the canopy.

***Betula nigra* (River Birch)**

For planting in the Yard, river birch that has been trained to a single trunk should be used, as opposed to specimens grown as a clump. The tree has peeling, buff-colored bark and is very tolerant of compacted soil. It is the only species of birch that can be considered reliably disease-resistant.

***Cercidiphyllum japonicum* (Katsura Tree)**

This is a beautiful, midsized tree that casts a light, delicate shade. It would make a nice addition to the Yard and is relatively maintenance free.

***Cladrastis kentuckea (lutea)* (Yellowwood)**

This elegant leguminous tree has performed well in other locations at Harvard and would grow well in the Yard. The tree produces its beautiful white flowers in early June, just in time for commencement. Because yellowwood tends to keep its lower branches, it needs to be sited in locations where heavy pruning is not required.

***Fagus sylvatica* (European Beech)**

This long-lived tree is already widely planted throughout Harvard. It is an excellent choice for the north sides of buildings that are shady and cool and where foot traffic is minimal. We particularly recommend the upright form 'Fastigiata' for areas where there is not enough room for a full-sized, spreading specimen.

***Ginkgo biloba* (Ginkgo)**

While stiff and awkward when young, the tree develops great character as it ages. It is tolerant of a wide range of soil conditions, and if given enough sun and moisture, grows quickly. The fan-shaped leaves turn a beautiful clear yellow in autumn. Only male plants with a spreading habit, as opposed to the narrow 'Fastigiata' clones, should be planted.

***Larix decidua* (European Larch)**

This deciduous conifer is tolerant of compacted soil and would add a nice touch of yellow fall color to the yard. Being of relatively narrow growth habit when young, it could be used in fairly close proximity to buildings. It can be limbed up with impunity.

***Liquidambar styraciflua* (Sweet Gum)**

Sweet gum is very tolerant of compacted soils and has extremely beautiful fall color. The tree is not a favorite with maintenance people because it drops spiny "gumballs" in the winter, two months after leaf fall, necessitating a second cleanup.

***Nyssa sylvatica* (Tupelo or Black Gum)**

This species has sensational fall color and beautiful winter form. While somewhat slow to establish itself and difficult to transplant, tupelo would make a nice addition to the Yard if we could locate large specimens.

***Tilia petiolaris* (Pendant Silver Linden)**

This is one of the most beautiful of the lindens because of the silvery white underside of the leaves and because the branches are gracefully weeping. The tree grows to be quite large and, relative to other lindens, has good fall color.

***Ulmus parviflora* (Lace Bark Elm)**

This is one of the few elms that is truly resistant to Dutch elm disease. While not as tall or graceful as the American elm, it has beautiful, exfoliating bark and an airy crown composed of small leaves with good fall color. On the down side, lace bark elm tends to leaf out several weeks later than other elms.

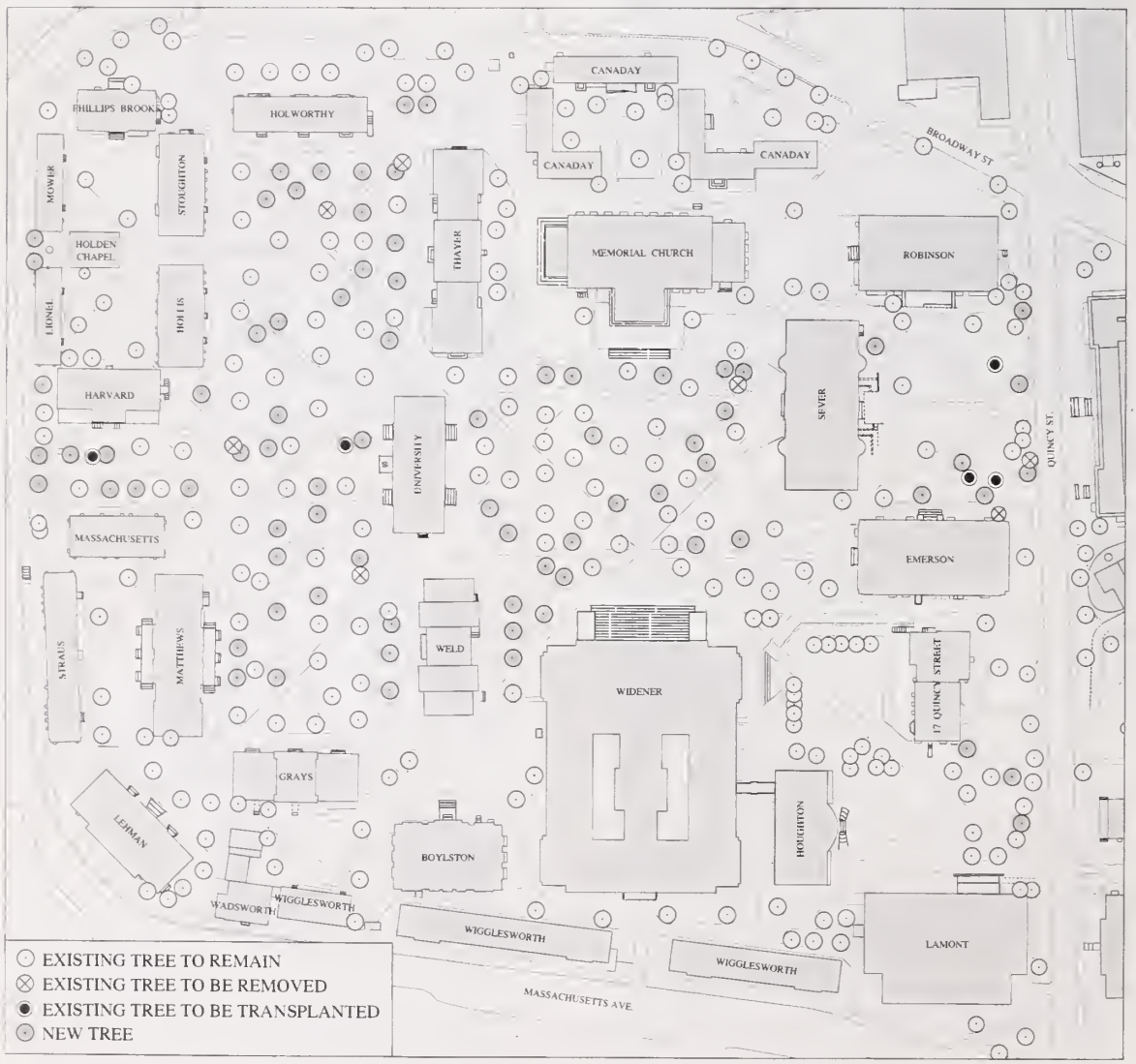
***Zelkova serrata* (Zelkova)**

This species is often touted as a replacement for the American elm, but it is considerably smaller in stature. For planting in the Yard, we recommend using one of the tall, upright selections such as 'Village Green', as opposed to random seedlings.

The previous list identifies the trees that the committee selected as appropriate for use in Harvard Yard; the list on the right gives the trees actually obtained in nurseries for the first phase in the Yard replanting program. The map shows which existing trees will be retained, which will be removed or transplanted, and where new trees will be sited.

The Old Yard (on the left of the map) is bounded by Holworthy, University, and Grays Halls. The Tercentenary Theater is delineated by Widener Library, Memorial Church, and Sever and University Halls. Sever Quad (on the right) extends from Sever Hall to Robinson and Emerson Halls and Quincy Street.

HARVARD YARD REPLANTING PROGRAM PHASE ONE (1994)



Qty.	Botanical Name	Common Name	Old Yard	Tercentenary Theater	Sever Quad
9	*Acer rubrum* 'Red Sunset'	Red Sunset Red Maple		9	
2	*Acer saccharum* 'Green Mountain'	Green Mountain Sugar Maple	2		
1	*Aesculus hippocastanum*	Horse Chestnut	1		
2	*Catalpa speciosa*	Catalpa	2		
3	*Celtis* x 'Magnifica'	Magnifica Hackberry	3		
7	*Cladrastis kentuckea*	Yellowwood		7	
6	*Gleditsia* 'Shademaster'	Shademaster Honey Locust	4	2	
3	*Gymnocladus dioicus*	Kentucky Coffee Tree		3	
2	*Liquidambar styraciflua*	Sweet Gum	2		
12	*Liriodendron tulipifera*	Tulip Poplar Tree	9		3
2	*Nyssa sylvatica*	Tupelo	2		
1	*Pinus strobus*	White Pine	1		
1	*Quercus acutissima*	Sawtooth Oak			1
1	*Quercus alba*	White Oak			1
1	*Quercus imbricaria*	Shingle Oak	1		
4	*Quercus coccinea*	Scarlet Oak	4		
3	*Quercus macrocarpa*	Bur Oak		2	1
2	*Quercus palustris*	Pin Oak	1	1	
4	*Quercus phellos*	Willow Oak	3		1
5	*Quercus rubra*	Red Oak	5		
5	*Sophora japonica*	Japanese Pagoda Tree	5		

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The Care and Feeding of the Noble Allée

Marc Treib

Two of France's most engaging seventeenth-century landscapes are once more being rethought.

The story goes that a certain professor of landscape architecture at a California university was dismayed by what a French student had proposed for her second planting design project. The trees were, in fact, arranged in two very straight and parallel lines, arranged in what in her country of origin is termed an *allée*. The professor's sole comment was, "Hmmm. So you've lined them up again?" After a moment or two of searching for a more pointed response, he played his trump card, "But what if one should *die*?"

What indeed? He needn't have worried. After all, trees have been growing—and *dying*—in French allées for three centuries, more or less. But questions of life process within the garden are central to any landscape design, and to some extent they are made more transparent in gardens conceived geometrically. When the pattern is apparent, the presence—or absence—of any single element is highlighted. If a tree anchoring the corner of a square is missing, that loss is more noticeable than one fallen within an informal clump. But in spite of the test of horticultural skill, formal gardens have been created in virtually every part of the world, either as domestic or imported products. Trees arranged in lines have constituted a central feature of landscapes from the *tunnello* of Renaissance Italian gardens to the *allée* of French formal gardens to the street trees of nineteenth-century American cities. Allées are a magical part of the formal garden.

But what if one should die?

Versailles may be Andre Le Nôtre's largest work, but two of his most engaging designs are the gardens at the Tuileries and the park at Sceaux. The first has always been an element of the city, now circumscribed by Paris and the Seine. Like Central Park it is a respite from urbanity rather than a place where the city meets the field. Sceaux, on the other hand, located south of the capital, was created as an exurban estate to serve as a retreat from both the city and the suffocating protocol of the court. Today, it hosts dog walkers, runners, the elderly, soccer fanatics, model boat pilots, lovers, and those who derive pleasure from photographing long lines of Lombardy poplars.

The Tuileries

Until 1871, the gardens of the Tuileries spread outward from a palace of the same name, which had been recast during two prior rebuildings. By 1576, the château had already broken out of the enclosure surrounding the almost perfectly rectangular garden of the medieval structure.[1] The domain changed drastically with Louis Le Vau's major building renovation of 1664 and the vast plan for the grounds proposed by André Le Nôtre (1613–1700), the royal gardener.[2]

Tuileries. Newer plantings in the grid of the Grand Couvert. Horse chestnuts predominate (Marc Treib).

Tuileries. The central allée extending the axis of the Louvre to the arch of La Défense. Many of the trees are relatively young (Marc Treib).

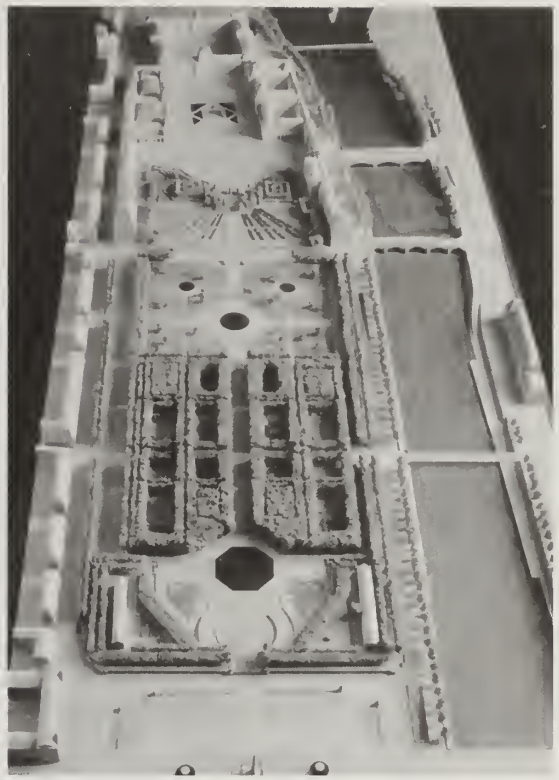
His scheme, which was more or less realized by 1680, figured the garden as a play of varied arabesques planted within rectangular parterres; the dimensions of each were carefully adjusted to conjure a sense of regularity when the site wished otherwise.[3] Typical of Le Nôtre's designs, many of the purely geometric figures were adjusted to counter the foreshortening apprehended from the palace to the east, from which point the principal views were cast. To disguise the slope across the site, banks were raised along its northern and southern edges. Ramps joined the principal levels and a set of horseshoe-shaped ramps connected the ground with the embankment at the garden's western terminus.[4] In Le Nôtre's time rows of trees extended the thrust of the axis from palace to fields. Today a forest of regularly planted (mostly) horse chestnuts *(Aesculus hippocastanum)* extends the line through from the Tuileries, past the vast Place de la Concorde, along the Champs-Elysées to the Arc de Triomphe, through the Porte Maillot and, as of 1989, on to the square arch at La Défense.

Le Nôtre's vision was elegant, restrained, and gridded; architectonic areas adjacent to the palace gave way to bosks of mixed plantings. Here, horse chestnuts planted on a grid roughly fifteen feet apart (known today as the "Grand Couvert") defined spaces within the larger space, provided shade as a respite from the summer sun and served as a screen for dalliance. As depicted in contemporary engravings, the design of the bosks was not consistent. Some were high, some low; some intricate, some simple. This permitted, within a structural theme, variation in form, use,

and amount of sunlight within an order immediately perceived. On the north terrace, silkworm-nourishing mulberry trees had been planted during the royal experiment to develop a silk industry. Horse chestnuts replaced them in 1677 as part of the great renovation, at which time spruce also entered the garden.[5] In other parts of the garden, lindens replaced elms, originally planted in clipped bushes of varying heights and trees of varying species.

The Tuileries had traditionally been open to the polite segments of the population; in the aftermath of the Revolution the park became a National Public Garden.[6] But political imbroglio nevertheless took its toll on the vegetation and the château. Burned by the Paris Commune on May 23, 1871, the Tuileries palace stood as a ruin for over a decade while its fate was debated. In 1882, the remnants of the building were pulled down, the site was cleared and reformed as a link between the Louvre and the Tuileries. In the later part of the nineteenth-century, during the reign of Napoleon III, the land that once accommodated the palace was reserved for imperial use.[7] Over the centuries various species of trees—London planes *(Platanus* x *acerifolia),* for example—crept into the garden although horse chestnuts continued to predominate.

In 1990, an invited competition was held for the redesign of the Tuileries gardens.[8] While the principal instigation for the contest was the great renovation by I. M. Pei to the adjacent Louvre, the garden itself was in serious need of study and reinvigoration. The care of the garden had been attached to the duties of the architect for the Louvre; no master plan guided maintenance and replanting, and over time the grounds began to show the piecemeal decisions of generations of gardeners. The scheme selected for execution (by Pascal Cribier and Louis Benech with François Roubaud) accepted the Le Nôtre structure as a framework within which to work, but called for major reformations to the design of the bosks and to the ground beneath the trees. New pools were to be added, new bedding, new



A model of schemes for the Tuileries by Cribier-Benech-Roubaud (foreground) and Wirtz (radiating lines in the background. The Seine is on the right (EPGL/ F. Caplaine).

plantings, new modulations of the ground plane; all within Le Nôtre's prevalent structure.[9]

The results appear, at first glance, to be conservative and archaeologically pure, with a prevalent formality that conforms to the historical structure of the park. But with a more careful viewing, one finds changes effected at the level of horticultural execution.

Within the bosk areas, for example, new plantings of linear hedges will softly articulate the space beneath the trees. Most of these lines will remain low, planted with Alexandrian laurel *(Danae racemosa),* flowering raspberry *(Rubus odoratus),* and cranesbill geranium *(Geranium macrorhyzum).* In certain areas, however, the vegetation will form a true hedge. The proposed lines of hedges will be

Tuileries. A principal allée paralleling the Rue de Rivoli, seen with the raised embankment at the far right (Marc Treib).

purposely overwatered and used as irrigation for the horse chestnuts, which have not prospered in the polluted Parisian air, a problem compounded by relatively dry summers of late.

The landscape architects have also produced a protocol for maintenance and restoration to guide future work within the gardens. Having been a royal domain, the Tuileries remains directly under the administration of the Ministry of Culture's Department of Preservation, and prior to the competition there had been no firm policy for maintaining the integrity of the Le Nôtre or any other design. Instead, as is so often the case, the decisions were made by the gardeners on a day-to-day, item-by-item basis. Historically, the royal gardeners seemed more interested in sustaining a planted rhythm than in maintaining a species-pure planting. Although the gardens have relied on horse chestnuts, a number of alien species have been planted: one London plane, for example, is dated as about one-hundred-fifty years old. Other species were planted as the horse chestnuts were lost.[10]

Policy toward planting continues to evolve. Mr. Jean Schnebelen, technical director for the Department of the Hauts-de-Seine's Espaces Verts (forests, parks, and gardens), noted that the horse chestnut, long the mainstay of French parks and formal gardens, is becoming increasingly more difficult to procure; nurseries prefer to cultivate lindens, and hence, these are more available. Horse chestnuts are also plagued by a fungus that appears at the end of the growing season and whose effect is only too noticeable in the brown edging of the leaves in late summer and autumn. In place of the golden tones taken by their northern cousins, in Scandinavia for example, the canopies

Tuileries. A typical bosk in the Grand Couvert (Marc Treib).

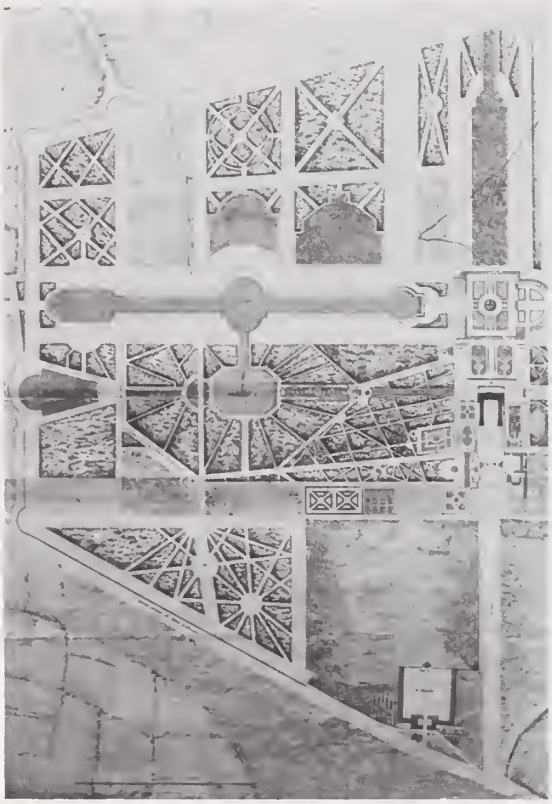
of the trees in the Paris area appear as an unattractive agglomeration of dun-toned pennants hanging limply from their branches.

Today, the multiple allées are far from pure in family and age, although the effect of the gridded bosks overwhelms these disparities. Only the specialist would notice that all is not coherent in the state of the Tuileries; the Le Nôtre structure predominates.

Sceaux

If the Tuileries is an urbane and restrained green setting in which the city echoes, the park at Sceaux is a gash of geometric order incised into the countryside. The château one sees today is not the original built around 1670 by the same Jean-Baptiste Colbert who managed the seventeenth-century renovation of the Tuileries gardens. That structure, like the palace of the Tuileries, was destroyed in the last century. The existing building, an emblem of the decline in taste and means in the centuries that followed in the wake of the Grand Siècle, is undersized and meager in comparison to the park itself.

At the request of Colbert's son the Marquis de Seignelay, Le Nôtre executed major renovations and additions to the gardens from 1685 to 1696.[11] The cross axis, set parallel to the château terrace, was strengthened by a new and quite Grand Canal, which collected groundwater while contributing to the garden an enormous mirror in which to reflect the skies and the glory of the patron. In the earliest existing plan, which dates from 1730, the triple allées of trees surrounding the Grand Canal are carefully delineated, but the species of tree intended by the landscape architect cannot be ascertained with any precision. They are rendered only as generic shapes; no specif-



Sceaux. Detail of the 1730 plan (Musée de l'Ile de France).

ics are listed. Perhaps the available or acceptable species were so well established that there was no need to note them. Perhaps the landscape architect was more interested in the structural and spatial purposes served by the long rows of trees and less interested in the means by which to realize them. Elm, horse chestnut, and slightly later, linden, were frequently used in formal gardens such as these, and one can assume that at least one of these species would have been used at Sceaux (that is, if the allées were ever planted in their entirety).

Whatever the species, the trees had long deteriorated by the first decades of this century. By the 1920s the entire park was in desperate condition. Segments of the stone walls of the Grand Canal had collapsed, and only scrubby planting maintained the lines intended by Le Nôtre. The site was considered a health hazard, the canal waters were stagnant and fetid, and the once majestic water feature was caustically described as "an open sewer."

Ownership of the park was transferred from private ownership to the Department of the Seine in 1923, and the public cry for greater attention ultimately resulted in a major refurbishing of the park.[12] The canal, which had been the target of public abuse, was drained, rebuilt, and waterproofed;[13] an allée of Lombardy poplars was planted to ring the canal. The refurbished park was officially opened in 1935. The landscape designer Russell Page, visiting Sceaux in the mid-1930s, could report: "Now the canal has been cleaned; lines of Lombardy poplars have been planted down each side and there are boats and facilities for swimming. The work continues and, by degrees, as much of the old Park as possible will be developed in playing fields and tennis courts."[14] By the end of the 1930s the trees were beginning to mature and by the close of the following decade, they began to display signs of the majestic scale they possess today.

Populus nigra 'Italica' entered France for the first time only in the mid-eighteenth century, that is, long after Le Nôtre. Thus there was no historical precedent for this choice of tree. But today the poplars are so dense, dramatic, and architectonic, that it is difficult to conceive of the canal without them. The Lombardy poplar is a tree accepted by gardeners but adored by architects. Cylindrical in shape with relatively quick growth and heights up to one-hundred feet, the Lombardy poplar is the perfect ingredient with which to create green architecture.[15] It also appeals to those who would realize a regrowth quickly. On the down side, the structure of its wood is brittle, the tree is relatively short-lived, and its roots can be invasive. They tend to destroy foundations like canal walls although this has not been a problem at Sceaux after the work in the 1930s.

Within the last few years, the poplars have matured to a point where their continued existence has become questionable. At sixty-five-plus years, they have nearly reached the

NEWS

from the Arnold Arboretum

A New Relevancy

Robert E. Cook, Director

The Historical Challenge

More than a century ago, a new institution was born through the vision of three men. Frederick Law Olmsted, newly appointed architect of Boston's park system, designed an extraordinary plan for the land. Charles Sprague Sargent, newly appointed head of the Arnold Arboretum, directed the assemblage of a magnificent collection of trees for scientific research. Charles William Eliot, newly appointed president of the Harvard Corporation, declared this Arboretum to be an essential part of a great educational enterprise, Harvard University.

Fifty-four years after its founding, the Arboretum faced a grave challenge upon the death of Sargent, its first and only director. How would this vision, nurtured by his leadership and supported by the annual generosity of his close associates, survive the financial storms ahead without the living spirit of its leader? Only a strong investment in the future, through the creation of an endowment fund in his memory, would secure the measure of financial stability needed to sustain its mission to collect and study the trees of the world. A goal of $1,000,000 was set, and a campaign was launched.

A loyal group of Sargent's friends from across the country rose to meet this challenge. And what friends they were. In New York alone, the Charles Sprague Sargent Memorial Fund was chaired by Henry James with J. P. Morgan serving as treasurer. They

Arboretum education initiatives aim to make children partners in science learning.

raised $1,021,884. Today, the Arnold Arboretum is known the world over for its leadership in the study of trees, especially those of the Asian continent.

A New Relevancy

It has been sixty-six years since that great campaign on behalf of the Arboretum. Today the institution faces a new challenge. Our world has grown very small in the last half century. The common environment that sustains our daily existence is under increasing assault. Where once Sargent would have traveled thousands of miles to collect the seeds of exotic Chinese trees, today those rich forests of temperate Asia have been decimated by the axe. Over the past several decades, the accelerating loss of forests in tropical Asia has contributed to irreversible changes in the very climate that surrounds us all.

Closer to home, the next generation of children, who will inherit this altered world, are leaving our school system unprepared for the future. We are failing to educate all Americans in the basic understanding of science and technology that permits them to evaluate critical environmental issues and execute the obligations of responsible citizenship.

It is no surprise that all of our institutions are being called upon to transcend their traditional mission of scholarship. Much more than in the past, their resources are being asked to address urgent social, economic, and international issues through direct service to society.

The Arboretum has heard this call, and we are in a unique position to respond. On the one hand, as part of Harvard University, we curate the collections and cultivate the knowledge that will be required for the resolution of pressing problems. (See box below on the upcoming expedition to China.) On the other hand, as part of the urban fabric of Boston, we experience an added obligation to transform this knowledge into service for the community around us. Consequently, we have begun to answer this call.

With the support of international agencies such as the World Bank, we are bringing the expertise of our staff to collaborate directly with the governments of Asian nations. Working closely with country scientists, we are providing assistance for the conservation of their critical biological resources through botanical exploration and inventory, the identification of promising medicinal plants, and the generation of forest management policies that can enhance sustainable development.

Here in our own community, the Arboretum has become a center for science learning among the schoolchildren of Boston. Each year we bring hundreds of classrooms to experience our landscapes, and we work directly with elementary teachers to enhance their knowledge of basic biology and support their instruction of science in the classroom. Through the use of telecommunications technology, we will soon link neighboring schools in Boston and Brookline directly with each other and with the educational resources of the Arboretum. This electronic community will reinforce the development of a social community for science learning through our collaborative work with families, teachers, and their students.

Because this service to society is an amplification of our historic mission, it places new demands on our financial resources. We must continue our traditional role of curating our collections and fostering scholarship. At the same time we must confront a challenge today that parallels that confronted by Sargent's associates sixty-six years ago. How can we ensure that our present commit-

The Arboretum is pleased to announce its participation in a plant-collecting expedition to Wudang Shan Mountains in Hubei Province, China, planned for Fall 1994. As a member of the North American China Plant Exploration Consortium (NACPEC), which will cooperate with the Nanjing Botanical Garden in this venture, the Arboretum will be represented by Peter Del Tredici, Assistant Director for Living Collections. Other members of the Consortium who will be participating in the trip include Longwood Gardens, Morris Arboretum of the University of Pennsylvania, and the U.S. National Arboretum.

ment to apply our knowledge to urgent societal problems will not erode in the face of future financial pressures?

The Challenge for a New Generation

We must look once again to our friends for help. Our goal is $8,000,000, to be secured in an endowment for the service of a new relevancy in our mission. This goal matches, in today's dollars, the aspirations of the Sargent Memorial Fund sixty-six years ago. As part of The University Campaign, it reaffirms the vision of our founders and the commitment of Harvard to it. The Arboretum Campaign calls forth the confidence and support of our friends to invest in the future of our augmented mission. At a time when our children and our world look to us for leadership, the challenge is clear and our obligation unambiguous. With this help, we shall meet this challenge again.

Adapted from the May 13 Supplement to the Harvard University Gazette.

First Impressions of the Arnold Arboretum from a Winter Transplant

Kim E. Tripp

The very first impression was of snow—deep in spots, and cold down my boots—but definitely not too deep to keep me from tramping (and sliding, slipping, and bumping) along a slick conifer path to the firs—firs with whom I had been greatly looking forward to renewing a friendship. That was on the first day, and I finally stood below one of the *Abies* x *umbellata,* whose limbs were bowed ever so slightly with that same snow. Snow that, while less than thrilling down my boots, was perfect garb for the striking dimplecone fir. Snow that seemed to somehow stay miraculously new and fresh for weeks (because, in reality, it actually did—I'm certain it snowed at least once a day during my first weeks here). Snow that, after seven years in snowless climes, was nothing less than sheer pleasure to me, even as it hung on in stubborn, dirty lumps, melting into April's mud. The snow was an old friend made new again for me by the trees at the Arnold—a kind of arboreal renewal I keep finding around every bend in the living collections.

The Arnold Arboretum has a long history of plants and plantspeople, a history that is

Karen Madsen

Kim Tripp arrived at the Arboretum in February as a Putnam Fellow with a two-year appointment to do research, teaching, and writing focused on the Arnold's living collections. Kim comes to us from the North Carolina State University Arboretum where she worked with Dr. J. C. Raulston as a postdoctoral research associate. She acquired her Ph.D. in Horticultural Science from North Carolina State and an M.S. in Vegetable Crops from Cornell University. She is a researcher with many skills and an impressive list of publications. At the Arnold she will be engaged in the evaluation and propagation of selected collections (including *Alnus* and *Cephalotaxus*), and in basic plant physiology research. She's seen above with *Cephalotaxus sinensis.*

never far from any endeavor here. The historical legacy of over 120 years of dedicated work by many individuals naturally runs the human gamut from bungling to brilliance, but it is apparent to any newcomer that brilliance has more often than not won out. As a result, the living collections at the Arnold are one of the great gifts of that historical legacy to the world.

But the Arnold's living collections are much more than a living legacy. As I go off in search of each day's elusive treasure (I know that last *Cephalotaxus* must be down this path somewhere . . .), I am struck by the sense of newness and ongoing evolution in these 265 rolling acres of woody plants. It is a sense that comes with the new growth on venerable *Picea wilsonii*, with freshly dug nursery trees stacked ready for planting, with the flats of rare young seedlings growing on in the greenhouse, with each unexpected encounter of the plant kind (Oh! Here's *Styrax obassia!*), or with the late evening light glowing through the grove of American beeches. After only a few weeks of exploring the grounds, I have already found favorite plants and places but, all of my efforts to the contrary, I have only begun to scratch the surface of the mind-boggling wealth of plants here.

It is that mind-boggling wealth of plants that brings someone like myself to the Arnold. My efforts to understand the growth and "behavior" of plants in horticultural environments, especially as relates to their roots, has often left me scratching my head over the unexpected differences between very closely related plants grown in the same environment. The environments we create for landscape plants generally bear little relationship to the environments in which those plants originally evolved and, therefore, can be far more stressful because of those disparities. Simple differences, like a plant's genetic disposition to invest more growth in roots than shoot, can allow it to thrive in environments fatal to other plants. The living collections of the Arnold offer an unparalleled opportunity to explore such differences in growth across an astounding breadth of plants, both between and within botanical families and genera, from an impressive range of native environments. I will be exploring such differences in growth in search of patterns that relate to their performance in different environments. By increasing our understanding of how woody plants survive and prosper in managed environments, we improve our chances of carrying a strong diversity of trees into the increasingly stressful and urbanized environs of the future.

I have been delighted to discover that the chance to work here offers me excellent access not only to the living collections themselves, but also to the experienced and insightful staff of the living collections—a unique opportunity that has already led to rewarding exchanges of ideas and information. In addition, the libraries are a world-class resource, where one can easily and happily lose entire days without realizing they have gone by and where I have found time to begin research for some of my writing projects.

But my first impressions of the Arnold Arboretum invariably come back to the plants, the trees, the thousands of wonderful woodies spread across Olmsted's lovely landscape through which one can wander again and again, from winter through fall, and continue to learn for a lifetime. Old giants and young saplings, fond familiars and exciting unknowns, native groves and exotic specimens, are all growing together to continually re-create this arboretum. This is a place of great complexity, a place of rich tradition and significant history, of modern challenge and new opportunity, of disciplined research and pure silvan magic—an unforgettable place I am coming to know as the Arnold.

Spring Planting

Peter Del Tredici

Karen Madsen

Julie Coop and Susan Kelley.

After the unforgettable winter of 1993–94, the staff and grounds crew of the Arnold Arboretum were particularly anxious to start the year's spring planting. As of this writing, seventy-five new trees have been planted on the grounds with an equal number yet to go in. We are most excited about the dozen new birches that have been set out, especially in view of the tremendous losses we have experienced in that genus over the last two years (seventy-plus trees removed). In terms of impact on the collections, devastation of the birches by the bronze birch borer

has been equal to or greater than that of the elms by Dutch elm disease. We wish the new birches a long and fruitful life.

Other notable additions to the collections are a small group of tupelos *(Nyssa sylvatica)* along the southern edge of Dawson Pond, including a rare specimen of *Nyssa sylvatica* 'Pendula'. We've also planted two new hardy pecans *(Carya illinoensis)* as companions to our one lone specimen. Come around in ten or fifteen years, and we'll have our own sweet pecans to brag about.

Karen Madsen

John Olmsted and John DelRosso pruning a honey locust on Peters Hill.

Karen Madsen

Jim Nickerson with the debris from the clean-up of the Lilac Collection.

Karen Madsen

Steve Spongberg, Peter Del Tredici, and a newly planted *Aesculus* x *carnea* 'Briotii'.

Karen Madsen

From left in front: John Olmsted, Jim Papagiris, Mark Walkama, Julie Coop, Joan Mullins; in the rear, John DelRosso, Karl Holmes, Pat Willoughby, Bruce Munch, Dennis Harris, Luis Colon, Bob Famiglietti (standing), and Don Garrick. Kenny Clarke, Jim Nickerson, and Maurice Sheehan are missing from the picture.

Programs & Events

During the summer, the Arnold Arboretum Education Department offers garden visits and tours, short courses in horticulture, and talks on many aspects of gardening. A selection of summer courses is shown here. For a complete catalogue of programs and events at the Arboretum, please call (617) 524-1718, ext. 162. Please note that fees shown in boldface are for members of the Arboretum. For information about becoming a member, please call (617) 524-1718, ext. 165.

HOR 330 Perennial Combinations for Summer

Elise Laurenzi, Garden Designer

Learn how to combine perennials for complementary texture and color whether you garden in full sun or partial shade. Participants will see how to combine native plants with exotics, select plants for foliage as well as flowers, and choose plants appropriate for a variety of sites. Cultural practices and design techniques for low maintenance will be discussed.

Fee: $16.00, $19.00

Monday, June 20/ 10:00–noon (Case Estates)

WAL 133 Private Gardens by the Sea

Katherine Alexander Field, Landscape Architect

Newport, Rhode Island, has a long and romantic garden history. The former estate gardens, with their staffs of gardeners, are largely a thing of the past, but the Newport tradition of gracious gardening remains. Smaller gardens flourish now in the benign Newport climate. In a full day of garden visits, we will be escorted by Newport-area landscape architect Kate Field, who will show us lovely private gardens, and discuss the gardening traditions of Newport, past and present.

The gardens will be near the peak of bloom for roses as well as the classic palette of perennials. On one of our stops we will enjoy a picnic among the flowers, overlooking the sea. A special day for garden lovers.

Fee: $110.00, $125.00. Fee includes transportation and lunch.

Friday, June 24/ 8:00 am–6:00 pm. Bus departs from the Arnold Arboretum Main Gates.

Margot Balboni

Rosa rugosa 'Salt Spray'

HOR 110 Fundamentals of Gardening

Laura Eisener, Landscape Designer

Whether you are a novice starting your first garden or an old hand looking for a firmer foundation, this practical course will satisfy your quest for basic gardening information. In the four sessions you will learn a variety of the basic principles essential to good gardening.

This course will cover basic techniques of gardening, including: site analysis and soil preparation, irrigation, drainage, watering, plant selection, and horticultural requirements of plants.

There will be some hands-on work at the site, in addition to lectures and demonstrations.

Fee: $85.00, $100.00

4 Thursdays, July 7, 14, 21, 28/ 9:00–11:30 am (Case Estates)

HOR 280 History Underfoot at the Arnold Arboretum

Richard Schulhof, Assistant Director, Education and Public Affairs, Arnold Arboretum

Although best-known for programs of botanical research and extensive collections of plants, the Arnold Arboretum with its 265-acre landscape contains a wealth of human and natural history. Based on historical research conducted under a recent grant from the National Endowment for the Humanities, this class will explore the evolution of the plant collections as well as the site's prehistory and its role in Native American, Colonial, and Country Estate periods. Wear comfortable shoes for this vigorous rain-or-shine walk.

Fee: $10.00, $12.00

Saturday, July 9/ 10:00 am–12:30 pm (Hunnewell Building and Arboretum grounds)

WAL 110 The Blue Hills — An Author's Perspective

Thomas Palmer, Naturalist and Author of Landscape with Reptile: Rattlesnakes in an Urban World

Question: What do rattlesnakes have in common with the Blue Hills?

Answer: Both have been the objects of years of fascinated study by author Tom Palmer.

Amy L. C. Wilson

Darrell Probst teaching an adult education course in perennials at the Case Estates, Weston.

Explore the Blue Hills with this author and naturalist who has spent uncountable hours exploring the Hills in search of *Crotalus horridus,* the timber rattlesnake. Palmer will lead a walk up his favorite peak and share his knowledge of the region's history, ecology, geology, and folklore and perhaps introduce some of its inhabitants. (Rattlesnake sightings, however, are not likely.)

The Blue Hills is a low range of hills just south of Boston. Participants should be prepared for a rigorous walk covering one to two miles of rugged terrain. Bring a snack and a beverage. Participants may also wish to bring a picnic supper to enjoy after the hike. Meet at Houghton's Pond in Milton. Directions will be sent with registration confirmation.

Fee: $12.00, $15.00

Sunday, July 10/ 3:00–6:30 pm (TBA)

HOR 134 Summer Flowering Shrubs

Paul Martin Brown, Naturalist and Horticulturist

The long hot, humid days of midsummer bring a wide variety of both color and texture to the shrub border. Many genera offer unusual species that deserve consideration in the design of the summer garden. This class will focus on the culture and habitat requirements of a range of mid- and late-summer flowering shrubs, including *Aesculus,* dwarf buckeye; *Vitex,* chaste-tree; *Buddleia,* butterfly bush; *Genista,* dyer's greenweed; *Clethra,* summer-sweet; *Clerodendrum,* glorybower; *Calluna,* heather; and many others. This is an outdoor walking course held rain or shine.

Fee: $21.00, $25.00

Friday, July 29/ 9:30–noon (Dana Greenhouses)

HOR 136 Ornamental Grasses

Darrell R. Probst, Horticultural Consultant and Landscape Designer

In the diverse world of ornamental grasses exist plants suitable for gardens of every size and for sunny, shady, wet, and dry locations. Some grasses are so large and dramatic that they can be used as shrubs or specimen plantings; others are miniatures, at home in the small-scale landscape. Their colors form a rainbow of greens, pinks, creams, blues, golds, and whites. This introduction to decorative grasses will focus on the culture, management, and design potential of these versatile perennials. Saturday's field trip will be to the Quansett Nurseries in Westport, MA.

Fee: $48.00, $55.00

Thursday, August 18/ 6:30–8:30 pm (CE) and 1 field trip, Saturday, August 20/ 11:30 am–3:30 pm (TBA)

WAL 235 The Rural Landscape
Marie Stella Byrnes, Herb Specialist and Landscape Designer

Spend a late-summer weekend enjoying a fascinating look at the many ways in which farmers and craftspeople have made a living under the harsh conditions of life in western Massachusetts.

In our two-day visit, we will see a wide variety of historic farms and rural work-sites, some restored to a previous era, others now serving new horticultural and agricultural uses.

Hall Tavern Farm, the state's oldest privately owned tree farm. Produces farm and forestry goods such as specialty paneling and wainscoting.

William Cullen Bryant Homestead, a landscape restored to the 1865–78 period. Includes escorted tour of the house interior.

Ashfield Stone Quarry. Mica schist, formerly quarried by ancient methods, is now quarried with state-of-the-art computerized equipment. Quarriers and stone carvers will be working on the design and fabrication of garden ornaments.

Kirin Farm, formerly a commercial apple orchard, established in 1820, and now the grounds and gardens of landscape designer Marie Byrnes. We will see remnants of the old orchard, along with the currently producing fruit and nut orchard. Garden rooms include a white moon garden, a pocket Japanese area with an ornamental pool, an herb garden, and a hillside planting that incorporates fruit-producing shrubs and oversized herbs.

Penfrydd Farm grazes llamas, sheep, and Norwegian fjord horses. Colorful hand-dyed yarns and handwoven blankets are produced for sale.

Wheel-View Farm, a former dairy farm, now a bulb and cut-flower nursery. Gladiola, dahlia, canna bulbs, ismene, calla, and crinum lilies are produced for sale.

Saturday lunch will be served on the grounds of one of our stops. Participants may book overnight accommodations at nearby bed-and-breakfasts. List of suggested accommodations will be sent with registration confirmation.

Fee includes all admissions and Saturday lunch.

Fee: $75.00, $86.00

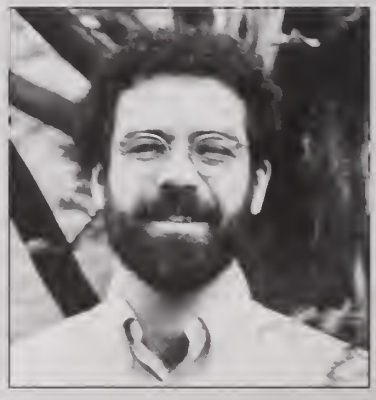
Saturday, August 27/ 10:00 am–4:30 pm and Sunday, August 28/ 9:30 am–1:30 pm (TBA, Charlemont, MA)

New Staff at the Arboretum

Karen Madsen

This past January we were pleased to welcome Sheila Baskin as the Arboretum's new secretary, whose role it is to provide support for the Public Programs, Development, and Living Collections Departments. She brings several years of administrative and secretarial experience to her position. A long-time resident of Boston, Sheila enjoys working with the public and has shared her enthusiasm with many Arboretum visitors this spring.

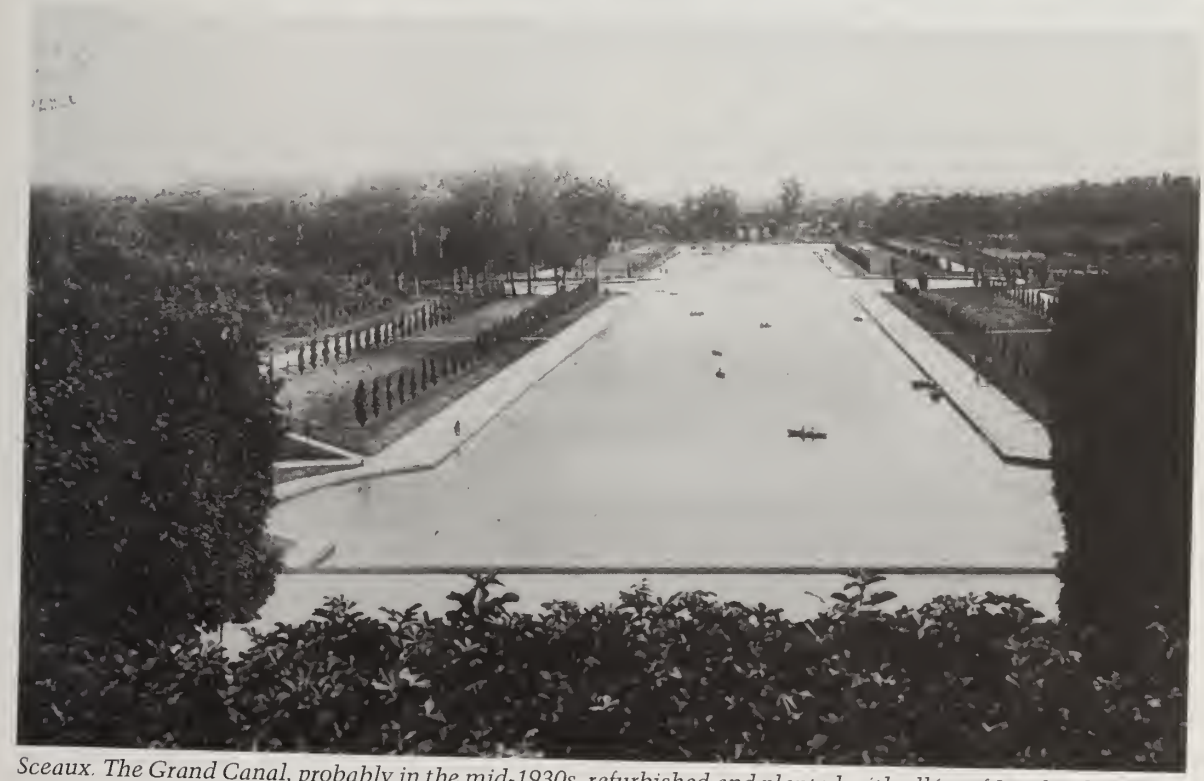
Paul Groff is the newest curatorial assistant at Harvard University Herbaria. He came last December from Berkeley, California, where he was working as a music teacher and instrument repairman. He has recently been inserting Arnold Arboretum specimens transferred from Jamaica Plain into the Cambridge collection. After years spent in the West he is enjoying the seasons and the deciduous



Karen Madsen

trees of Massachusetts and looks forward to Saturdays in the Arboretum this spring.

Sceaux. The Grand Canal, derelict, in 1924 (Musée de l'Ile de France).



Sceaux. The Grand Canal, probably in the mid-1930s, refurbished and planted with allées of Lombardy poplars (Musée de l'Ile de France).

Sceaux. The poplars already mature, probably in the 1950s (Musée de l'Ile de France).

end of their expected life span. A major storm in February 1990 destroyed a sufficient number of the trees to force a rethinking of the planting strategy around the canal. Sceaux, after all, is not a small and private garden but a major public park that seems to host an international meeting of canal joggers each evening as the sun sets.

In places, *Quercus robur* 'Fastigiata' (upright English oak) has been planted to replace those poplars that have passed on to allée heaven. Presumably its narrow and upright form while young made it a viable choice to substitute for the Lombardy poplar. That it may acquire a pyramidal form when mature seems to have been of less concern to those responsible for new plantings. In the interest of truth-in-arboriculture these new trees have been clearly marked by signs noting that the planting is only experimental. The experiment, in fact, has not been going well. According to Mr. Schnebelen, who is responsible for maintaining the park's vegetation, the oaks have taken very poorly and are, in many places, dying. No new solution has been found, and there is a possibility that in spite of their limited longevity, the poplars will be replanted.

For the most part, the poplars around the Grand Canal have been left untouched and are pruned on an individual basis as required. Certainly they have not received the constant grooming lavished on the linden allées approaching and extending from the château. These plantings (called *arbres rideaux*, or "curtain trees") are clipped annually when in leaf, usually between May and September. What was once accomplished with ladders, clippers, and a sort of whiplike pole with a blade at its end—still to be seen in use at Vaux-le-Vicomte—is now executed with electric shears

Sceaux. Experimental planting of fastigiate oak, marked with a sign, 1992 (Marc Treib).

Sceaux. The Grand Canal in 1993 (Marc Treib).

in the hands of gardeners elevated in a cherrypicker. In spite of this contemporary technology, the task remains enormous given the kilometers-long allées that structure the idea of Sceaux.

The French, however, remain up to the task. At Sceaux even more than the Tuileries, the allées have received as much care as funding allows.[16] In the summer, the shade of the allées at Sceaux provides welcome relief from the long day's sun. Like blinders on a horse, they direct—or coerce—the visitor to continue moving: first to the château, then to the cascade, down to the octagonal basin, and, of course, on to the canal. In winter the dense and intricate branch structures become sculptural forms set against the sky. In any season, however, the line of the planting and the rhythm of the interval modulate the walk of those who follow the directed path.

Is this, yet again, the French predilection for valuing geometry and architectonic purpose over natural growing patterns? Perhaps. But the conflict between nature and human construct does not create a major problem. Gardening practice will continue to evolve to meet the changing environmental, economic, and political conditions, whether in the use to which the park space is assigned or in the selection of species. The traditional allée will receive its care and feeding.

But, again, what if one should die? In some instances, the eye will continue what nature has removed; the mind will complete the gap. The missing element can, in fact, create a syncopation that enriches rather than detracts from the rhythm. A missing tree can actually contribute to a design, as a young tree can remind us of the life cycles of living organisms. And then, if one should die, you can always plant a new one.

Notes

[1] Androuet du Cerceau, *Les Plus Excellents Bastiments de France* (1576, 1579), reprint edited by David Thomson (Paris: Sand & Conti, 1980), 220–225.

[2] The project for château and garden was conceived by Jean-Baptiste Colbert, Secretary of State and Director of Public Works to Louis XIV, to woo the Sun King back from his seat at Versailles. (It didn't work.)

[3] For a chronology of the gardens at the Tuileries, see F. Hamilton Hazlehurst, *Gardens of Illusion: The Genius of André Le Nostre* (Nashville: Vanderbilt University Press, 1980), 167–186.

[4] Today this overlooks and forms one side of the Place de la Concorde, one of Paris' most sublime traffic carrousels.

[5] Hazlehurst, 183, note 9. Hazlehurst translates what was probably *sapin* in the original as Norway spruce. Louis Benech suggests that the species was more likely the native *Abies pectinata* (silver fir).

[6] See Jean-Pierre Babelon, "Les Tuileries dans l'histoire et dans la ville," 5–13, and other essays in *Monuments Historiques*, Les Tuileries (November 1991), No. 177.

[7] In the years from 1881 to 1893 this area was recast by château architect Edmond Guillaume in a quasi-mirroring of the first panel of the Le Nôtre scheme. Thus, on the site of the demolished palace, circular beds substituted for the pools of water, and specimen planting gave the garden a slight flavor of the fashionable English and/or gardenesque manner. While a trifle discordant in taste and form, Guillaume's scheme succeeded in joining the Louvre to the Tuileries garden proper through symmetry and repetition. His task was made more difficult by the extension of Rue des Pyramides southward to the Seine as Avenue du Général Lemonnier. The road effectively separated the Louvre from the gardens.

[8] See Tanis Kmetyk, "The Politics of Gardening," *Paris City* (July 1993), 20–27, for a candid report of the competition, its implementation, and the politics that influenced its realization.

[9] Sadly, politics reared its ugly head, in a manner characteristic of France but almost impossible to explain on any rational level. The Cribier-Benech-Roubaud scheme was truncated; Jacques Wirtz, another competition invitee, was given the design of the Cour du Carrousel. The two teams were thus forced into a marriage of inconvenience, and judging from the resulting design—the clash of competing ideologies was aggravated by the Pei terrace between them—the menage looks to be made for divorce. The reasoning behind the Wirtz

scheme is difficult to ascertain, and the relation of the radiating hedges to the embankment against which they will bump due to a level differential, appears clumsy at best. That the Tuileries will be designed in fragments is unfortunate; the opportunity to once again reunite the full sweep of the gardens has been lost.

[10] François Roubaud believes that on average some fifty trees per acre are cut and replaced each year, and that as a result a considerable portion of the park's trees is actually quite young.

[11] For a historic overview of Sceaux, see Hazlehurst, 233–256.

[12] Philippe Diloé, "Sceaux," *Beaux-Arts* (Vol. VIII), 1931, unpaged.

[13] Hazlehurst (234–236) believes this waterproofing to have been a mistake because it may have hastened the collapse of segments of the canal's retaining wall shortly after the refurbishing. Root intrusion could have been the primary culprit, however.

[14] Russell Page, "Sceaux: A Château Garden," *Landscape and Garden* (Winter 1936), 211.

[15] Robert Riley of the University of Illinois has anointed this the Fragrant I-Beam School of Landscape Design, with trees and shrubs substituting for plywood and concrete. The Washingtonia palm is another I-beam par excellence, with only a small topknot of greenery to suggest that it is actually alive and growing.

[16] Like most places in the world, the maintenance budgets for the park systems of Paris and the surrounding areas have been drastically reduced. The number of gardeners tending parks like Sceaux has dropped accordingly, making even routine upkeep a challenge.

Acknowledgments

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"A Most Dangerous Tree": The Lombardy Poplar in Landscape Gardening

Christina D. Wood

The history of the Lombardy poplar in America illustrates that there are fashions in trees just as in all else.

"The Lombardy poplar," wrote Andrew Jackson Downing in 1841, "is too well known among us to need any description."[1] This was an extraordinary thing to say about a tree that had been introduced to North America less than sixty years earlier. In that short time, this distinctive cultivar of dominating height had gained notoriety due to aggressive overplanting in the years just after its introduction.

The Lombardy poplar *(Populus nigra* 'Italica') is a very tall, rapidly growing tree with a distinctively columnar shape, often with a buttressed base. It is a fastigiate mutation of a male black poplar *(P. nigra).*[2] As a member of the willow family (Salicaceae)—North American members of the genus include the Eastern poplar *(Populus deltoides),* bigtooth aspen *(Populus granditata),* and quaking aspen *(Populus tremuloides)*—the tree prefers moist, rich soils but tolerates a wide range of conditions. Easily propagated from woody stem cuttings, it is hardy from Zone 9 to 3 and can attain its full height of one-hundred feet or more in twenty to thirty years. With a spread of only ten to fifteen feet, it presents a striking form in the landscape.

The Lombardy was disseminated throughout Europe in the mid-eighteenth century from Italy, where it was found growing on the banks of the Po River in Lombardy. There was speculation in the nineteenth century that it may have originated in Persia or perhaps the Himalayan region; because the plant was not mentioned in Roman agricultural texts, writers reasoned that it must have been introduced to Italy from central Asia.[3] But subsequent writers have thought it more likely that the Lombardy sprang up as a mutant of the black poplar. Augustine Henry found evidence that it originated between 1700 and 1720 in Lombardy and spread worldwide by cuttings, reaching France in 1749, England in 1758, and North America in 1784.[4] It was soon widely planted in Europe as an avenue tree, as an ornamental, and for a time, for its timber. According to at least one source, it was used in Italy to make crates for grapes until the early nineteenth century, when its wood was abandoned for this purpose in favor of that of *P. nigra.* The first cuttings to reach England were planted at Blenheim,[5] where the cultivar can still be seen.

It was the avid plant collector and landscape gardener William Hamilton who introduced the tree to North America. Documents indicate that his use of the tree followed practices in Great Britain and Europe. In 1788, a visitor to the Woodlands, Hamilton's showplace on the Schuylkill River west of Philadelphia, wrote that the walks were "planted on each side with the most beautiful & curious flowers & shrubs. They are in some parts enclosed with the Lombardy poplar except here & there

Lombardy poplars on Boston's Fenway, 1919 (E. H. Wilson).

openings are left to give you a view of some fine trees or beautiful prospect beyond . . ." One of Hamilton's own letters indicates other uses. In 1789 he referred to a flower border "in front of the necessary [privy] skreen of cedars & Lombardy poplars." The leftover poplar cuttings were to be planted "in the Gaps long the orchard fence next the road placing them as not to exceed a foot from each other as the season is so far advanced they should be planted very deep or will fail. 2 Eyes above ground will be enough."[6] The first American guide to planting, published in 1806 by Philadelphia nurseryman Bernard M'Mahon, also recommended it as a hedge.[7] Its sheltering qualities were widely recognized, and for this purpose it was to be cut at top and sides to form a narrow green wall. "It is an excellent tree for sheltering or shading either fields or gardens in a flat country; but care must be taken to plant it at a sufficient distance; and, where shelter is wanted without shade, not to introduce it on the south side of any garden or orchard, unless at a distance of at least twice its ordinary height."[8]

Easily propagated and rapid of growth, the Lombardy quickly became exceptionally popular and demand for it was high. A short thirteen years after its introduction at the Woodlands, a nursery in Newton, Massachusetts, devoted two full acres to its cultivation.[9] The next year (1798), the Prince Nursery in Flushing, New York, advertised ten thousand Lombardy poplars for sale, each a height of ten to seventeen feet.[10] By the early years of the nineteenth century it was said that "they infested the whole island [of Manhattan], if not most of the middle, northern, and many southern States."[11]

European use of the Lombardy as an avenue tree had not gone unnoticed in North America. John Claudius Loudon had recorded in his influential *Arboretum et Fruticetum Britannicum* of 1838 "an avenue of Lombardy poplars, the oldest and the highest in Germany; none of the trees are under 90 ft. high, and many of them are above 120 ft. Nothing of the kind can be more sublime."[12] In images of Boston made shortly after the turn of the nineteenth century, they can be seen lining Park Street, along the top of the Common. Americans, in a great hurry as always, prized the rapid growth that brought nearly instantaneous shade. No doubt they were very beautiful while they lasted, and they offered ancillary benefits: "The elevation of the tree is also favourable for inviting and protecting singing-birds . . . Since the streets of some of the American towns have been planted with Lombardy poplars, the [Baltimore] orioles are constant visitors . . ."[13]

There is nothing like widespread use to uncover the weaknesses of a plant, and the Lombardy's shortcomings got ample exposure. Problems appeared shortly after the tree came into widespread use on streets. Like other members of the genus, its wood is weak and prone to break. The roots disrupt sidewalk

The Lombardies that encircled the tomb of Jean-Jacques Rousseau at Ermenonville, France, formed one of Europe's most famous tree plantings. The tableau was often imitated (Promenade ou itinéraire des jardins d'Ermenonville *[S. Girardin], 1788).*

The 1915 caption read: "This tree has a special landscape value which no other tree possesses and under special conditions it can be used to better advantage than other trees" (Levison, American Forestry, *Vol. 21).*

pavement above ground and penetrate and clog water and sewer pipes below ground. Boston's Park Street Lombardies were replaced by American elms as early as 1826. By 1871, an ordinance compelled the removal of existing specimens and banned the planting of new ones in Albany, New York. By then, many cities, including Washington, D.C., and Brooklyn, no longer tolerated the Lombardy.[14]

By mid-nineteenth century it had fallen from favor elsewhere, too. Downing, that period's chief arbiter of landscape taste and American disseminator of English practices, complained in 1841 that it had been so overused as to become "tiresome and disgusting."[15] Another writer commented in 1870 that "when first introduced into this country the rage for it was so great that town streets, and country roads, and farm-house yards, were everywhere filled with them; but familiarity has bred contempt."[16] Just before the turn of the twentieth century, Marianna Van Rensselaer noted that "we do not see it so often, although our fathers dearly loved to plant it. It has suffered much from disease in recent years, and, moreover, the canons of such gardening taste as we possess say that its formality is inappropriate in naturalistic landscape-scenes."[17]

Notwithstanding reservations, it was acknowledged throughout the nineteenth century and into the twentieth that properly used, the tree played a significant role in the land-

"A degree of sublimity"

John Claudius Loudon's *Arboretum et Fruticetum Britannicum*, published in eight volumes over the years 1834 to 1837, remains an important compendium of centuries of information on British trees, native and introduced. In it, he gave eleven pages to the Lombardy poplar, saying, "We have been induced to enlarge on the subject more than we should have done, from seeing the frequent misapplication of the tree in the neighbourhood of London, as well as its good effects in various instances."* He therefore offered several examples "to show how easy it is, by means of the Lombardy poplar, to add to the effect of a landscape, or to destroy the harmony of its different parts. In short, the Lombardy poplar, like the weeping willow and birch, is a most dangerous tree in the hands of a planter who has not considerable knowledge and good taste in the composition of landscape." Below are some of Loudon's examples.

1

The Lombardy poplar, considered as a tall conical mass of foliage, becomes of great importance in scenery, when contrasted with round-headed trees. It is a known rule in the composition of landscape, that all horizontal lines should be balanced and supported by perpendicular ones; and, hence, the bridge [at Blenheim] in figure 1, displaying a long and conspicuous horizontal line, has its effect greatly increased by the poplars planted on each side of it. Not only the lines of the bridge are balanced and supported by the upright poplars, but lengthened and pleasing reflections from the water are produced; which, breaking the horizontal gleams of light, not only produce variety and richness, but by increasing the length of the perpendicular lines formed by the poplars, confer a degree of sublimity on the picture: since it is allowed by all writers on the material sublime, from Burke to Dugald Stewart, that gradually tapering objects of great height create the emotion of sublimity.

This poplar, or some equally fastigiate tree, should appear in all plantations and belts that are made with a view to picturesque effect; as in figure 2 where the outline is varied as well as the face of the plantation. Masses of round-headed trees, such as figure 3, though they might be seen to advantage in some situations, when grouping with other objects,

2

yet, when contemplated by themselves, are quite uninteresting, from their dull and monotonous appearance; but add the poplars, as in figure 4, and you immediately create an interest and give a certain character to the group, which it did not before possess. . . . The branches of the poplars, rising stiffly upwards, contrast with, and render more graceful, the horizontal or pendant masses of the round-headed trees; and the stems of the poplars being clear of branches to a greater height than the other trees, form an agreeable variety in the lower part of the group.

3

4

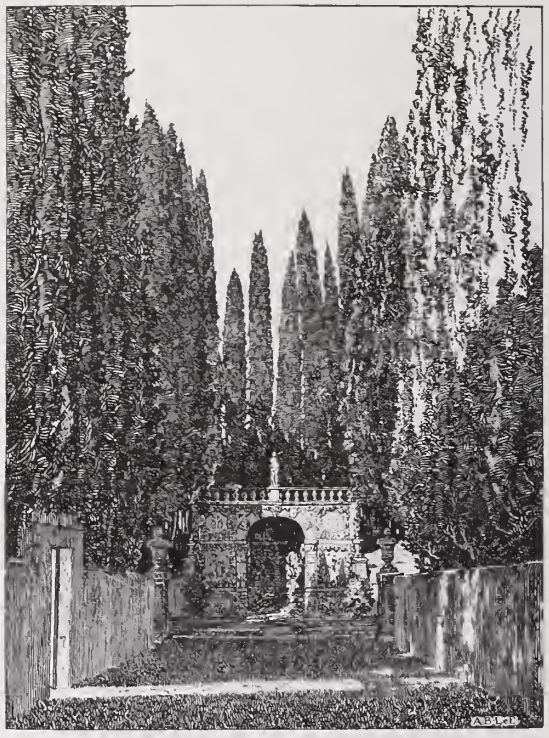
* Loudon, *Arboretum et Fruticetum Britannicum*, Vol. III (London: A. Spottiswoode for the Author, 1838), 1660–1670.

scape. Downing recognized its beauty and the elegant effect it could produce when employed to give "life, spirit, and variety to a scene composed entirely of round-headed trees . . . when a tall poplar, emerging here and there from the back or centre of the group, often imparts an air of elegance and animation to the whole."[18] In L. H. Bailey's influential *Standard Cyclopedia of Horticulture,* first published in 1900, it was recommended "to give such points of emphasis in green landscape as does the church-spire in the village."[19] And the Lombardy was surely one of the plants Guy Lowell had in mind when he wrote in *American Gardens* in 1902:

> An American traveling abroad is sure, after seeing the formal gardens of Rome and of Northern Italy, to wish to reproduce them in some form in his own country. He does not always remember that climatic conditions are not the same . . . different flowers, trees, and hedges have to be used in attempting to produce effects similar to those in Italy, for it is impossible to grow here many of the broad-leaved evergreens which give so much character to the villa gardens of Rome. The lines and masses may be similar, the principles of design may be the same, but the effect in detail is different, for different elements must be used, or must needs be changed to meet new conditions.[20]

The resemblance of the Lombardy's narrow, aspiring head to that of the Italian cypress *(Cupressus sempervirens)* came in very handy in the Gilded Age when wealthy Americans acquired the taste and means to import European models of landscaping. In an early, relatively modest instance, artists and writers, beginning with the sculptor Augustus Saint-Gaudens in the 1880s, transformed New England farmhouses in Cornish, New Hampshire, into versions of hillside Italian villas. A 1906 article in *Century Magazine* described Saint-Gaudens' use of Lombardies:

> Lombardy poplars have more than once been used with excellent effect by Cornish gardeners, and, what is rarer, with reserve . . . The single poplars, which, on Mr. Saint-Gaudens's place, stand one on each corner of the terrace



Cypress Alley, Villa Gamberaia, Italy, as illustrated in An Introduction to the Study of Landscape Design *by H. V. Hubbard & Theodora Kimball, 1915.*

> are planted solely for their architectural value. The house is rather narrow and high. These tall, slender "Lombardys" seem to belong to the scheme of the house and bring it into better proportion.[21]

It was in Cornish, on his own property and that of four neighbors, that the artist, architect, and landscape designer Charles Platt developed the Italianate villa style that played such an important part in the country house movement in turn-of-the-century America. He used the Lombardy as Italians use their cypress, to frame views and accent architecture.[22]

The poplar's susceptibility to disease has been problematic since its earliest years of cultivation in Europe and North America. It is prone to a canker-forming fungus that kills the tree from the top down, destroying its shape and shortening its lifespan. Cryptodiaporthe

An allée of Lombardy poplars directs visitors through the entrance of an estate in Lenox, Massachusetts, 1920 (Archives of the Arnold Arboretum).

canker, also known as Dothichiza canker, is one of the major diseases of poplars in general, but it affects the Lombardy most severely. Identified in the United States in 1915, the canker occurs wherever Lombardies grow, but regional conditions and the preexisting health of the individual plant appear to affect the extent of infection. No cure is known.[23]

So while the Lombardy is still grown, especially in Mediterranean climates or more northern regions, for many of us in the Northeast it persists mostly as a memory. If Downing were writing today, he could no longer say that it is too well known to need description. For so many years a lead player in the cast of trees favored for landscape effect, it has become a bit player in most schemes. But its splendidly dramatic size and form ensures a memorable impact whenever it makes an appearance.

Notes

[1] Andrew Jackson Downing, *A Treatise on the Theory and Practice of Landscape Gardening* (1841; reprint, Little Compton, R.I.: Theophrastus Publishers, 1977), 154–155.

[2] W. J. Bean, *Trees and Shrubs Hardy in the British Isles*, 8th ed. (London: John Murray, 1976), 320. Bean writes that the so-called "female Lombardy poplars" are almost certainly seedlings of typical *P. nigra* pollinated by "Italica," and are generally less columnar than the male parent.

[3] John Claudius Loudon, *Arboretum et Fruticetum Britannicum; or, The Trees and Shrubs of Britain,*

Vol. III (London: A. Spottiswoode for the Author, 1838), 1661.

[4] Augustine Henry, "The Black Poplars," *The Gardeners' Chronicle* (July 4, 1914) LVI, Third Series (1,436): 1–2.

[5] Loudon, 1660, 1662.

[6] Karen Madsen, "To Make His Country Smile: William Hamilton's Woodlands," *Arnoldia* (Spring 1989) 49(2): 19.

[7] Bernard M'Mahon, *American Gardener's Calendar* (Philadelphia: B. Graves for the Author, 1806), 257.

[8] Loudon, 1668.

[9] U. P. Hedrick, *A History of Horticulture in America to 1860* (NY: Oxford University Press, 1950), 146.

[10] Stephen A. Spongberg, *A Reunion of Trees* (Cambridge, MA: Harvard University Press, 1990), 80.

[11] J. W. Francis. *Old New York; Or Reminiscences of the Past Sixty Years* (New York: Charles Roe, 1858), 23, quoted in Spongberg, 60.

[12] Loudon, Vol. I, 147.

[13] Loudon, 1666–1667, quotes *The Magazine of Natural History*, Vol. I, 418.

[14] J. J. Levison, ed., "Ornamental and Shade Trees," *American Forestry* (October 1915) 21 (262): 995.

[15] Downing, 152.

[16] Frank J. Scott, *The Art of Beautifying Suburban Home Grounds* (NY: D. Appleton, 1870), 363.

[17] Mrs. Schuyler [Marianna] Van Rensselaer, *Art Out-of-Doors* (NY: Charles Scribner's Sons, 1893), 274.

[18] Downing, 152.

[19] Warren Manning, "The Art of Designing Landscapes," *The Standard Cyclopedia of Horticulture*, ed. L. H. Bailey, Vol. II, 2nd ed. (NY: The Macmillan Company, 1928), 1786.

[20] Guy Lowell, Introduction, *The American Garden* (Boston: Bates & Guild Company, 1902), unpaged.

[21] Frances Duncan, "The Gardens of Cornish," *Century Magazine* (May 1906) 72: 3–19.

[22] Keith N. Morgan, *Charles A. Platt: The Artist as Architect* (NY: The Architectural History Foundation: 1985), 24–26. Morgan writes that Platt "worked broadly with existing stands of mature trees, favoring groves of birches and pines and adding Lombardy poplars for architectural accents."

[23] Wayne A. Sinclair, Howard H. Lyon, and Warren T. Johnson, *Diseases of Trees and Shrubs* (Ithaca, NY: Cornell University Press: 1987), 184.

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Punctuating the Skyline: Alternatives to the Lombardy

Karen Madsen

> Tree-experts may warn me that they are liable to borers and bark-lice, and that they lose their leaves early in the season, and in many ways invite the use of the axe. It may be so. I have enjoyed them, however, for a number of years and they are entirely healthy yet, although surely a score of years in age. It will be a long time, therefore, before an axe under my direction will touch them. Even the tendency to lose their leaves early in the season would not induce me to use the axe, for their lofty spire-like forms dominate everything and establish that variety of skyline so much to be desired by the lawn-planter. Let the limbs be bare and the trunk scarred and seamed with borers, the noble outline is there . . . Samuel Parsons (1891)

More than a hundred years later, there remain "lawn-planters" who stand with the nineteenth-century superintendent of New York City Parks on this issue—dedicated, as he was, to the proposition that the Lombardy poplar offers qualities not available in other trees. For these steadfast few, "the noble outline," the fast growth, sublime height, and sinuous leaf movement are irreplaceable and irresistible, more than offsetting a short life made shorter still by canker. In the face of all odds, they continue to plant the Lombardy. But for those whose commitment to the problem-ridden Lombardy falls short of Mr. Parsons', there are other fastigiate trees that are worthy of consideration for specific situations.

Populus sp.

The Lombardy hadn't been long in cultivation when one special quality was noted by William Gilpin (1791), that is, "the waving line it forms when agitated by the wind. Most trees, in this circumstance, are partially agitated: one side is in rest, while the other is in motion. But the Italian poplar waves in one simple sweep from the top to the bottom, like an ostrich feather on a lady's head." All poplars have the flattened leafstalk that makes the Lombardy's blade so responsive to the wind, and thus another poplar is a logical choice to replicate its movement and sound. *Populus tremulus* 'Erecta' (upright European aspen) or *P. alba* 'Pyramidalis' (Bolleana or fastigiate white poplar) are candidates, although not free of problems themselves. The latter can be seen on the Charles River Esplanade in Boston. Very like the Lombardy in habit (although rather wider in proportion to its height), it can be recognized in summer by the cottony white of the underside of its leaves. It is easily propagated, but does not grow as fast as the Lombardy nor quite so high. Like many fastigiates, which concentrate their resources on growing upright instead of spreading, it tends to become bare at the base.

Quercus robur 'Fastigiata' (Upright English Oak)

Nearly all long-cultivated trees have deviated into erect-growing—as well as weeping—forms, and among them is the oak, emblem of strength and longevity. The upright English oak is large and imposing; a mature tree may be sixty feet or more in height with a span of only ten to fifteen feet. When leafless, it greatly resembles the Lombardy in form. It has the advantage of being longer-lived and freer from insect attack, although mildew can be a serious problem.

Since oaks are relatively difficult to propagate vegetatively, cultivated specimens are generally grown from seed, which creates the possibility of wide variation in form. Most seedlings—as many as eighty or ninety percent

Populus alba *'Pyramidalis' rises like a vertical spire from a horizontal line of trees on the Charles River. Esplanade, Boston, giving contrast to a weeping willow and providing the exclamation point in a composition of rounded trees. All photos by the author.*

according to Dirr—do acquire the columnar habit of the parent. Specimens that grow true to form approach the Lombardy in outline and effect.

Fagus sylvatica 'Fastigiata' (Fastigiate or Dawyck Beech)

The fastigiate beech shares the grace and majesty of its parent species, as well as its beauty, especially when twigs take on a purplish tinge in the spring sunlight and the shapely buds have begun to expand but are still enclosed in their delicate, bronzy carapaces. It is also true to the species in its glossy foliage, smooth gray bark, and fibrous roots. The fastigiate cultivar can attain eighty feet.

Dense and amenable to shearing, it makes an admirable hedge, screen, or wall. Its breadth is greater than the Lombardy's or the upright oak's, and its density gives it a bushier form than either. The fastigiate beech seen in a photo to the right is one of three that stand in a sunken garden in Boston's Back Bay. Now fifty years old, they have broadened to a pear shape; with age, side shoots tend to come off the main branches and to splay out, especially with the weight of rain. In the past few years, the lower third of these trees have been pruned.

Acer rubrum 'Armstrong' (Armstrong Red Maple)

Both 'Armstrong' and *A. rubrum* 'Columnare' are grown at the Arnold, but here it is the Armstrong that is more nearly upright. Fast growers (as much as twelve feet in five to seven years according to Dirr) and moderately weak-wooded, they can attain seventy or more feet in height, gradually spreading out over

Quercus robur *'Fastigiata' (upright English oak) in Weston, Massachusetts.*

Fagus sylvatica *'Fastigiata' (fastigiate or Dawyk beech) on Marlborough Street, Boston.*

Acer rubrum *'Armstrong' (Armstrong red maple) at the Arnold Arboretum.*

Carpinus betulus *'Columnaris' (the Schmoo hornbeam) at the Arnold Arboretum.*

Carpinus betulus *'Columnaris' among other* Carpinus *at the Arnold Arboretum.*

time from an initial width of about fifteen feet. They share the early spring flowers, lovely silver-gray bark, and fall color of their species. The Armstrong serves well as an avenue tree, especially in crowded urban conditions.

Carpinus betulus 'Columnaris' (Columnar Hornbeam)

The sheltering qualities of the Lombardy are more than equally supplied by the columnar hornbeam (or the "Shmoo," as it is affectionately known at the Arnold). If the height of this relatively small (forty to sixty feet) and narrow tree is too great, the plant accepts pruning very well. However, its dense habit is by itself so neat that it looks naturally as though it had been sheared. With its impenetrable branches, the columnar hornbeam makes a superb hedge, and as a sheltering screen it is hard to beat. Its very erect branches take a slender spire-like form when young, later approaching the oval, but always very striking and elegant.

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Karen Madsen is editor of *Arnoldia.*

IN MEMORIAM

Jennifer Reimer Quigley

1946–1994

It is with deep regret and sadness that we record the death of Jennifer Reimer Quigley on 30 March 1994, after a three-month battle with cancer. Known to many as Jennifer Hicks, Jennie joined the staff of the Arnold Arboretum on 29 March 1976 as Horticultural Secretary, a position she held until she took charge of the plants records office in March of 1979.

It was in this latter position that Jennie truly found her niche at the Arboretum, a position that utilized her numerous talents and skills of organization, cartography, calligraphy, and her great attention to detail. To the position she also brought her considerable knowledge of botany and horticulture and botanical nomenclature, not to mention her great persistence in seeing enormous tasks to completion. Literally thousands of zinc records labels were created by Jennie on the now-antiquated addressograph machine, and the vast majority of records in our computer database were her entries.

Jennie was also instrumental in evoking change in the fundamental ways in which the records, labeling, and mapping office operated to insure the proper curation of the Arboretum's living collections and to make information readily available to all who needed it. It was during Jennie's tenure that the Arboretum staff began the initial computerization of the living collections files under her direction, an attempt that was doomed by virtue of hardware failure, but one that led to the development of BG-Base and the establishment of a computer network at the Arboretum. Working as Kerry Walter's chief Arboretum consultant, Jennifer's imprint is present throughout the plant records side of BG-Base, the computer software that is now used at the Arnold Arboretum and at botanical gardens and arboreta worldwide.

Over her eighteen years at the Arboretum Jennifer was also responsible for training and supervising a cadre of horticultural interns, many of whom have gone on to career positions at other botanical gardens and arboreta. It was a recurring and familiar event when one of these former interns would return to the Arboretum, specifically to seek out their former mentor in her basement office, which prior to the renovation of the Hunnewell Building served as the nerve center for the living collections department. While deeply involved with the curation of the woody plant collections of the Arboretum during working hours, Jennie spent untold time in her own garden during late afternoons and evenings and on weekends. An active member of the New England Chapter of the Rock Garden Society, Jennie served that society in various capacities including board member and chapter chairperson from 1991 to 1993. In the plant world her true love focused on small herbaceous perennials suitable for cultivation in the rock garden, and her knowledge of these plants was encyclopedic. During the winter months, moreover, Jennie's free time was usually spent reading about plants, seeking sources for new unusual ones, and coaxing seeds received from fellow enthusiasts to germinate in the warmth of her comfortable, cat-inhabited home.

Ever helpful in providing needed information to both staff and the steady stream of visitors that came to study and utilize the collections at the Arboretum as well as her many friends on various computer networks, Jennifer Quigley will be sorely missed by all her friends. We have lost not only her efficiency and knowledge but also her humor, her straightforward approach to problem solving, her kindness, and her devotion to plants and the Arnold Arboretum.

—*S. A. Spongberg*

Arnold Arboretum Weather Station Data — 1993

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Max. Temp. (°F)	Min. Temp. (°F)	Precipi-tation (in.)	Snow-fall (in.)
JAN	37	21	29	59	22	2.49	8
FEB	33	14	24	47	16	4.49	7.5
MAR	41	25	33	68	24	7.08	38.8
APRIL	56	38	47	73	22	4.75	0
MAY	70	48	59	91	42	0.91	0
JUNE	79	54	67	91	40	1.73	0
JULY	85	62	74	99	49	2.49	0
AUG	80	62	71	97	52	2.81	0
SEPT	72	53	63	90	39	3.62	0
OCT	61	39	50	82	26	3.26	0
NOV	53	32	43	76	16	3.27	0
DEC	39	24	32	56	5	7.55	7.7

Average Maximum Temperature	59°
Average Minimum Temperature	39°
Average Temperature	49°
Total Precipitation	44.45 inches
Total Snowfall	62.0 inches
Warmest Temperature	99° on July 8
Coldest Temperature	5° on December 29
Date of Last Spring Frost	26° on April 8
Date of First Fall Frost	30° on October 11
Growing Season	185 days

Note: According to state climatologist R. Lautzenheiser, 1993 was very close to normal in precipitation and sunshine. The months of May, June, July, and August were sunny, hot, and dry, creating a drought-like atmosphere at the Arboretum. The high temperature of 99° was accompanied by twenty other days in the 90's. This was seven 90° days above our normal count. September brought a reprieve with cooler temperatures and abundant moisture. This trend continued through October, November, and December, allowing our plant material to recover before the freeze of winter. Overall, there were thirty-one more growing days in 1993 than in 1992.

Summer 1994

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Front and back covers: The astonishing *Welwitschia mirabilis*. J. D. Hooker described it as "expanding like a dream into a huge broad woody brown disc . . . of texture and surface like an overdone loaf." This photograph (B83024^c by Ron Testa) of the Field Museum's World of Plants diorama is used by courtesy of the Field Museum, Chicago.

Inside front cover: Parc des Buttes-Chaumont, Paris, in the engraving by Blanade that served as frontispiece to Edouard André's *L'Art des Jardins* of 1879.

Inside back cover: *Emmenopterys henryi* as drawn for *The Endemic Genera of Seed Plants of China* by Tsun-shen Ying, Yu-long Zhang, and David E. Boufford, published by Science Press, Beijing, 1993.

Welwitschia mirabilis—A Dream Come True

Gillian A. Cooper-Driver

It's been said that if botanists were to invent the ideal plant for a desert environment, surely they would never come up with a monster like *Welwitschia.*

Welwitschia mirabilis has always inspired extreme responses. It was the Austrian botanist and physician Dr. Friedrich Welwitsch, one of the foremost collectors of African plants, who first discovered this extraordinary plant in 1859, in southern Angola near Cape Negro. When he saw it, "he could do nothing but kneel down on the burning soil and gaze at it, half in fear lest a touch should prove it a figment of the imagination" (Swinscow, 1972). In the first detailed scientific description of the plant, Joseph D. Hooker, Director of the Royal Botanic Gardens at Kew from 1866 to 1885, wrote, "it is out of the question the most wonderful plant ever brought to this country, and the very ugliest." Recent papers published on *Welwitschia* have used such titles as "*Welwitschia*—Paradox of a Parched Paradise"; "*Welwitschia*, the Wonderful"; "Voyage into the impossible—I meet *Welwitschia*"; and "The ugliest plant in the world—the story of *Welwitschia mirabilis*. " I myself first heard of *Welwitschia mirabilis* about thirty years ago from a native of the Scottish isle of Iona, a long way from the deserts of southwest Africa where this strange plant grows. As we made our way in a small boat across the ocean, my companion told me of a strange plant, halfway between a flowering plant and a conifer, which Darwin had described as '"the platypus of the plant kingdom." From that brief encounter, it had always been my ambition to see the miracle plant for myself.

Welwitschia mirabilis grows naturally in only one area in the world. Its distribution is restricted to an extremely arid strip of land about seven hundred fifty miles long along the west coast of southern Africa, from the Nicolau River in Angola to the Kuiseb River in the Namib Desert of Nambia. The amount of rain in the Namib Desert varies greatly from year to year and ranges from zero to a half inch near the coast and two to four inches inland, as compared to a temperate deciduous forest, which receives approximately thirty to one hundred inches of rain a year. *Welwitschia* is not restricted to desert. It occupies the northern and central part of the Namib, but may also occur in subtropical grassland to the east and even in the Mopane Savanna (von Willert, 1985).

Off the shores of southwest Africa is the Benguela Current, which flows from south to north and is extremely cold. Warm onshore winds flowing over the cold water create a belt of fog that forms on the coast at night and often remains well into the morning. This condensed moisture gives life to many lichens and to other specialized forms of insects, animals, and plants—including *Welwitschia mirabilis.*

One of the most accessible places to see *Welwitschia* is in the Namib–Naukluft Park in the Welwitschia Flats between the Khan and Swakop Rivers, about thirty miles east of Swakopmund. This plain of weathered granite, quartzite, shale, limestone, and marble is

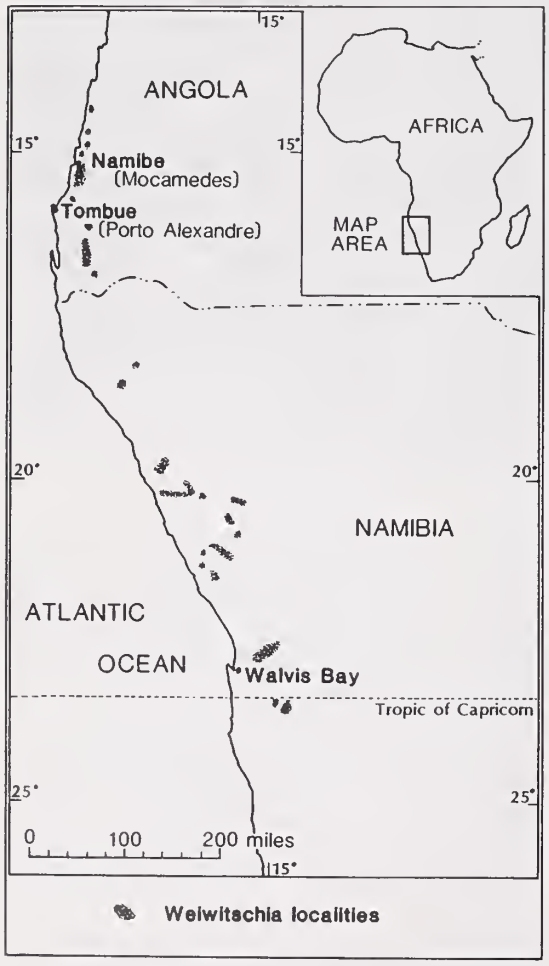
Welwitschia mirabilis *in the Namib Desert. Photo by the author.*

home to what are probably the oldest and most dense communities of *Welwitschia.* As many as five to six thousand specimens have been counted in this area.

It was a bright clear day, the first day in June, when I set out with two friends to find *Welwitschia mirabilis.* Before starting on the Welwitschia Plains Drive, it is necessary to obtain a permit and a guide pamphlet from the Ritterberg Nature Conservation Office in Swakopmund. The drive starts about three miles outside Swakopmund, a few yards from an abandoned steam engine. (This engine was imported to Namibia in 1896 to carry freight across the Namib Desert. Unfortunately, it survived only a couple of trips before grinding to a halt within sight of Swakopmund. It is named after the preacher Martin Luther, whose words, "Here I stand; God help me, I cannot do otherwise," are engraved on its pedestal.) At the engine you turn right and drive across the Swakop River to the entrance of Welwitschia Park.

The land around this part of the Swakop River is dry and at first glance entirely barren, resembling the spectacular images we have seen of the moonscape. However, closer inspection revealed several different plants. Among the more conspicuous were two drought-resistant shrubs, the dollar bush *(Zygophyllum stapfii)* with round succulent leaves similar to coins and the xerophytic

inkbush *(Arthraerua leubnitziae)* with its tiny leaves reduced to mere scales. Others were "!nara," or *Acanthosicyos horrida,* and "tsamma," or *Citrullis ecchirrosus.* Both of these plants provide a source of water for travelers in the desert. Parts of the moonscape are covered with a variety of lichens in colors of orange, black, and gray-green, the most conspicuous of which is *Xanthomaculina convoluta* with its bright yellow color and twisted filaments. These lichen fields, which are more extensive in the Namib than in any other desert in the world, depend for their survival on the condensed moisture that moves in from the sea at night.



The natural distribution of Welwitschia mirabilis. *Drawing by Clara Richardson courtesy of the Field Museum.*

Several miles into the moonscape, a road turns off to the left to form a loop leading to Goanikontes, an old farm near the Swakop River. Here many different trees are found: the camel thorn *(Acacia erioloba);* anaboom or white thorn *(Acacia albida),* the largest acacia; Cape ebony *(Euclea pseudobenus);* tamarisk *(Tamarix usneoides);* and introduced species of *Eucalyptus* and *Casuarina.* These trees provide shade from the hot sun and offer a startling contrast to the vegetation of the desert area. On this day in June, the farm was completely deserted and silent.

We left this fertile green area and returned to the moonscape. Granite cliffs, intersected with bands of black dolerite, rose on either side of the road, and then suddenly there they were, three *Welwitschia* plants growing up the sides of the gravel cliffs. The first sight of *Welwitschia mirabilis* is so totally unexpected in this bleak desert environment that it is easy to understand why Friedrich Welwitsch fell down upon his knees. Farther along the drive, the land flattens out, and more and more plants become visible. They spread across the desert, often in densely massed groups or in long lines fading away into the distance; it is rare to find a single plant all by itself. Using carbon–14 dating botanists have estimated that many of the smaller plants are thirty or forty years old, medium-sized plants a few hundred years old, and some of the larger plants are as old as fifteen hundred or even two thousand years.

It is *Welwitchia's* leaves that give this plant its strange appearance. It has only two permanent leaves. These stiff, strap-like leaves grow from a thick, almost totally submerged, woody stem and can be as much as ten feet in length. Since the leaves grow from their base, the cells at the tips are older and in time begin to turn brown and die. In the desert the leaves grow very slowly, about four to six inches per year. As the years and ultimately the centuries pass, the wind and the scouring sand split the leaves

In their natural habitat Welwitschias *occur in densely massed groups or in long lines fading away into the distance, as can be seen in this photo by the author.*

longitudinally into ribbons, some ten inches or more wide, supporting Bornmann's description of the plant as looking "like a stranded octopus on a bare desert surface." Leaf-stripping also occurs when oryx antelopes feed at the leaf base (Brinckmann and von Willert, 1987) or when microarthropods graze on the undersurface of the leaves (Marsh, 1987).

These leaves are unusual not only in appearance but also in size. Nowhere else in the Namib Desert does one see plants with such large leaves. One way for desert plants to deal with the scarcity of water is to develop anatomical and morphological structures that minimize water loss. For example, succulents like lithops and aloes, as well as the dollar bush mentioned earlier, have in their leaves a special central tissue that stores water (Von Willert *et al.*, 1992). Other plants, such as the inkbush, cope with the desert environment by having highly reduced, leather-like leaves, which minimize the loss of water vapor. Small leaves also reduce the high leaf temperatures that the intense solar radiation of a desert environment can cause. Therefore it is paradoxical to find a plant like *Welwitschia* with its very large leaves growing in the middle of a desert, especially since its leaves appear not to have special water storage tissues.

The leaves of *Welwitschia* are unusual not only in their structure, but also in their manner of development. The plant begins life as a winged seed. In a process similar to that of most broad-leaved flowering plants, the plant embryo first develops two primary leaves, or cotyledons. Above these and at right angles,

Welwitschia's *taproot grows to massive proportions. It can extend downward for as much as three to five feet; the apex shown here is about four feet in diameter. Courtesy of the Field Museum (360395), Chicago.*

the two permanent leaves arise, and the cotyledons wither away. Unlike all other land plants, no further leaves develop because the apical meristem (the cells from which leaves form) ceases all further activity and becomes nonfunctional. Only a pair of low crests representing primordia of a second leaf pair develop. Because it generally produces only two leaves, *Welwitschia* has been described by Martens as "a seedling arrested in development" or as "a plant without a head."

Plants use their leaves to manufacture sugars and other organic compounds from atmospheric carbon dioxide and water by the process known as photosynthesis. Carbon dioxide enters the cells of the leaf through special pores, or stomata, on the leaf surface. Water also enters and leaves the plant via stomata. Particularly important to plants growing in the desert is the ability to retain water and yet maintain a carbon dioxide balance so that photosynthesis can occur.

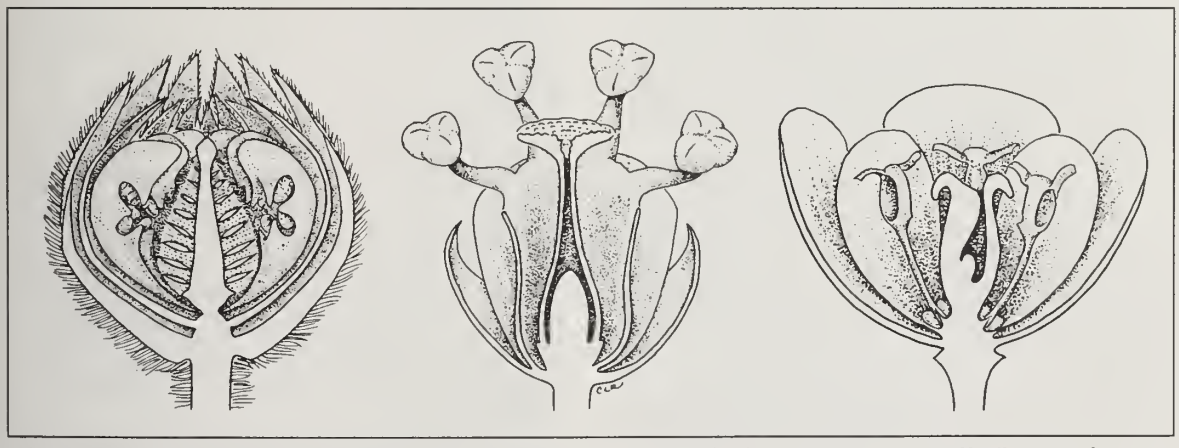
Welwitschia is again unusual for a desert plant in the way it obtains its carbon dioxide for photosynthesis. In most temperate plant species, stomata remain open during the day to take carbon dioxide from the atmosphere, then close at night. But in succulents and other desert plants, the process is reversed with stomata remaining closed during the day to reduce water loss and opening for water uptake at night (when atmospheric humidity is high and temperatures are low). Desert succulents also take in carbon dioxide from the atmosphere during the night, converting it into the organic acid malate by a process called crassulacean acid metabolism (CAM). During the day, when the stomata are closed, this malate provides a readily available source of carbon dioxide to allow photosynthesis to proceed in the normal way. Most succulents use CAM as a basis for their survival. It is therefore surprising to learn that *Welwitschia*, which lives in an environment that would favor CAM, behaves not like a succulent but like a temperate plant. Its stomata open in the morning and early evening, no organic acids accumulate during the night, and there is a marked daytime loss of water vapor from the leaves.

How then does *Welwitschia* obtain enough water to survive? One might suppose that *Welwitschia* acquires its water from the mist that settles over this part of the world. Some desert plants, such as members of the crassula family, have structures called hydathodes—specialized forms of stomata—that take in water from the air. However, *Welwitschia* leaves do not have these structures, and it appears that its leaves cannot absorb dew or mist water. A second possibility is that the water comes from the root. *Welwitschia* has a large taproot that extends downward for as much as three to five feet. Depending on the soil, lateral roots move out from the taproot at various depths, and multiple branches in the roots have been observed. It is possible that sufficient water is somehow available in the deepest soil layers and that *Welwitschia* taps into it through it deep-reaching root system.

While *Welwitschia's* strangely shaped leaves apparently serve no water-gleaning function, they do help it cope with the problem of heat, which causes water evaporation. Von Willert, who has worked on *Welwitschia* in the Namib Desert for many years, has found that only 55% of the solar radiation is absorbed in *Welwitschia's* leaves with as much as 40% being reflected away. (Compare this to most trees, from which about 25% of radiation is reflected.) Reflecting away the heat is probably the best strategy that a desert plant with large leaves can have for conserving water.

Other unusual features become apparent as one inspects *Welwitschia* more closely. The stem has a woody appearance and a large surface area. From the junction of the stem and the leaves arise branches on which the reproductive structures (the male and female cones) can be easily differentiated. By October most of these cones are fully developed. The cones indicate that *Welwitschia* is a gymnosperm, related to pines and other conifers. However, a closer look at the reproductive structures reveals several features that differentiate *Welwitschia* completely from the conifers. A notable instance is the presence of distinct male and female "flowers." The flowers on the male plant have a single ovule, which is surrounded by a fused ring of "stamens" that produce the pollen. Unlike the "ovule" in the female flower (as can be seen in the drawing below) the apex of the ovule in the male is expanded into a prominent funnel. This ovule never develops a mature seed. Instead, this sexually nonfunctional ovule may play a role in attracting pollinators as the funnel secretes a large drop of fluid precisely at the time the pollen is shed.

Pollination occurs from about November to the end of March. It is still not completely clear how the pollen reaches the ovules in the female cones. One might think it was carried by the bright red and yellow insects (yellow bugs and their red larvae), *Probergrothius sexpunctatus* (Pyrrhocoridae), that presented a dramatic sight when we saw them in June. However, all experts agree that red beetles and their larvae are not responsible for pollination; it would appear that other insects are respon-



The pollen-producing (male) inflorescences of Welwitschia mirabilis *have numerous small "flowers" borne in the cones. The reproductive organs resemble a tiny bisexual (or hermaphodrite) "flower" with a single sterile ovule (analogous to the female gynoecium in a female flower) surrounded by a fused ring of six structures (analogous to stamens). These latter structures produce the pollen. Although similar to a flowering plant, the ovule seems to be nonfunctional and never develops into a mature seed. The female "flower," on the other hand, has an ovule but contains no traces of stamens. Drawings by Clara Richardson courtesy of the Field Museum.*

Cultivating *Welwitschia*

Welwitschia was first grown successfully from seed to seed in the Botanic Gardens of the University of Stellenbosch, and it is presently being grown with considerable success in the Montreal Botanic Gardens; the Royal Botanic Gardens at Kew; and the Huntington Gardens, San Marino. Because of the fragility of its root system, it is best cultivated from seed. Even then, however, it is notoriously difficult. Of the ten to twenty thousands of seeds produced by a female plant, only twenty to two hundred may be capable of germination (Bustard, 1990). The most critical stage is the first six months of life, as seeds collected from populations in the wild are often heavily infested with the fungus *Aspergillus niger* (van Jaarsveld, 1992).

As described by H. Teuscher of the Montreal Botanic Gardens, growing *Welwitschia* is an enormously complicated business. First the seeds must be sown in very well drained pans containing granitic sand, crushed brick, and a trace of leaf mold. To ensure drainage the bottom of the pans should be covered with broken bits of crockery. The pans should then be covered with glass and placed in filtered light at a minimum temperature of 50 degrees F.

The seedlings must be watered from below to avoid damping-off disease. Under these conditions, the seeds of *Welwitschia* usually germinate within two weeks.

At five months the seedlings will have developed five-to-six-inch long unbranched taproots and must be transferred to clay drainpipes or clay pots that will accommodate the long taproot—the trickiest part of the growing process. A layer of broken crockery an inch-and-a-half deep should be placed in a twelve-inch pot with a drainpipe approximately three inches in diameter inserted vertically. Then the seedling is to be carefully inserted into the drainpipe, making sure the roots are fully outstretched. The drain can then be slowly filled with seedpan soil to a height of approximately three inches, followed by a mixture of one part crushed limestone and one part granitic sand, topped by a thin layer of crushed limestone. At this stage, the cotyledons should be lying flat along the top of the limestone. In the space between the pot and the drainpipe, two to three inches of topsoil and sand should be placed, followed by some leaf mold and a sprinkle of bonemeal and dehydrated sheep manure. Above this layer, crushed limestone and sand must be added, topped by a final layer of crushed limestone. Watering is done in the area between the drainpipe and pot. From April to September water should be enriched with a small amount of a complete liquid fertilizer, with plain water being used from the fall to the spring.

Teuscher, whose method represents the conservative end of *Welwitschia* culture, advises against repotting *Welwitschia* because of the serious hazard of damaging the root system. Instead, every three years after the plant is established, the stone and sand mixture along with the soil between the pot and drainpipe should be removed from around the roots. Fresh soil enriched with a small dose of fertilizer should then be added. In Teuscher's experience, it takes ten to twelve years for cones to develop.

Teuscher presents a daunting view of *Welwitschia* culture; however, others suggest that it may not be so difficult. For instance, Horwood goes so far as to say that it may not be necessary to cultivate the plants in drainpipes. Leo Song, Jr., maintains that these plants are not difficult to grow if certain basic conditions are given—full sunlight and abundant heat, protection from prolonged low temperatures, a fast draining growing medium, regular watering and fertilizing (preferably in a program of continuous feeding), and ample room for the root system. Song reports that he is growing *Welwitschia* in pumice in large pots with substantial success.

Van Jaarsveld also emphasizes the importance of allowing sufficient space for the taproot to develop. He attributes the success in cultivating *Welwitschia* at the Kirstenbosch Botanical Garden to bottom heat during the winter months, the rich, well-drained "Vanrhynsdorp" sand, and regular watering.

This model of a young Welwitschia *plant shows the stout taproot and the two leathery leaves that the plant retains throughout its entire life. Courtesy of the Field Museum (B81801).*

sible, possibly wasps, flies, or ants, and that the ovule's fluid may act as an attractant. Insects visit the drops of nectar secreted by the ovules in the female plants and in the process transfer pollen grains from the stamens of the male flowers.

After fertilization and following the sporadic February and March rains, the seeds fill out rapidly and the female cones spread their ripe seeds from about mid-June to mid-July. On the first of June, 1994, the seeds were just being released. By October, the mature cones will have shed virtually all their seeds and next season's cones will have appeared.

Welwitschia is generally classified as a gymnosperm in the division Gnetophyta. Within this division are three orders, Ephedrales, Gnetales, and Welwitschiales, each consisting of a single family and genus. Like *Welwitschia*, the two other members of this division are rather unusual. *Ephedra*, often called Mormon tea, is a shrub-like desert genus consisting of about thirty-five species and occurring in the United States in the deserts of California, Nevada, Utah, Arizona, and New Mexico. *Gnetum* is a tropical genus of about thirty species found as a clinging vine in the rainforests of Asia, northern South America, the Pacific Islands, and Africa north of Namibia. But even within its own division *Welwitschia* is distinctive—unusual in its appearance, in its geographical restriction, and in occurring only as a single species.

Ephedra, *Gnetum*, and *Welwitschia*, as a group, are regarded as the closest living relatives of the flowering plants (Doyle and Donoghue, 1993). Unlike the other gymnosperms, the Gnetophyta resemble angiosperms in having special water-conducting cells, called vessels, for increased efficiency in transporting water. Whether this implies a direct evolutionary relationship or is an instance of convergent evolution resulting from adaptation to desert environments is still a subject of some debate (Muhammad and Sattler, 1982). A possible evolutionary relationship between the Gnetophyta and the angiosperms is also suggested by certain reproductive characteristics, such as the unusual male "flowers" and in fertilization techniques (Gifford and Foster, 1989; Friedman, 1990).

All in all *Welwitschia mirabilis* is an uncanny paradox. In its unique development and ambiguous relationship to the flowering plants, its very existence is a challenge to botanists. Certainly it was a privilege to see this living legend.

Acknowledgments

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Gillian Cooper-Driver is an Associate Professor of Plant Biochemistry at Boston University. She has just returned from spending ten months at the National University of Lesotho on a Fulbright Award.

Mon cher ami: The Letters of Edouard André to Charles Sprague Sargent

Phyllis Andersen

The friendships formed by Charles Sprague Sargent over his long life were dazzling by anyone's account, international in scope, and carefully cultivated through correspondence.

Letters are a biographer's lifeblood, "unpremeditated transmitters of fact." Nothing else can convey the vitality of life as lived—the immediacy of emotions—so well as this intimate form of personal exchange. One of the most interesting items in the Archives of the Arnold Arboretum is a group of thirty-five letters to Charles Sprague Sargent, the founding director of the Arboretum, from the French landscape architect Edouard André (1840–1911). The letters, written in French, date from 1886 to 1905 and include two letters from André's son René written shortly after his father's death. The Arboretum does not have copies of Sargent's half of the correspondence, but it is likely that he too wrote in French as he knew the language well enough to translate DeCars' *Treatise on Pruning Forest and Ornamental Trees* (Paris, 1864) into English in 1881.

André's letters to Sargent reflect a friendship based on deep professional respect and personal affection. They shared a strong interest in plant exploration, in taxonomy, and the newly emerging theories of landscape style in park and garden design. They exchanged seeds, plants, and books. From time to time, when Sargent visited Paris, they met. (André visited the United States in 1876—as we know from his *L'Art des Jardins* where he mentions his admiration of Boston's garden cemetery—but no documentation of a visit to Sargent has been located.) André was Sargent's Paris connection, the source and expert on all things French. Despite clear differences in personality—Sargent diffident yet imperious, André clearly charming and gregarious—the two men were mutually supportive. They favorably reviewed one another's books and noted each other's accomplishments in their respective publications. They shared a strong attraction to large, challenging projects and an avid curiosity about the world.

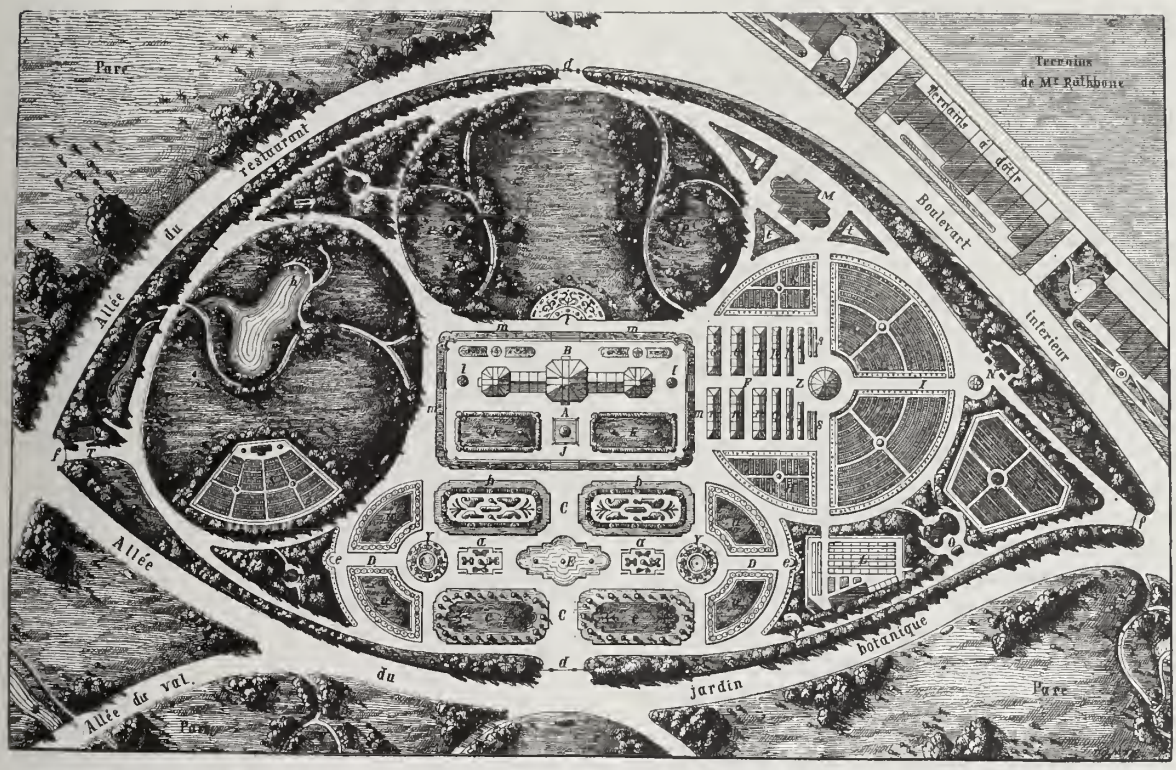
Edouard André is known to landscape historians as a designer, an *architecte-paysagiste,* a visible figure in the Parisian park-building projects directed by Baron Haussmann for Napoleon III in the last half of the nineteenth century. He is the author of a comprehensive text on garden and park design, *L'Art des Jardins,* the designer of hundreds of private gardens and numerous public parks, a friend of Frederick Law Olmsted and of the English garden writer and designer William Robinson. In 1892 he was appointed Professor of Garden Architecture at *L'Ecole d'Horticulture de Versailles,* the first person to hold that position.

To horticulturists, André is known as a plantsman with strong credentials. He was a self-described botanical traveler. In 1875 he was sent by the French government on a plant-

On the left, Edouard André in a portrait that appeared in Volume 47 (1895) of the English journal The Garden, *which was dedicated to him. On the right is Charles Sprague Sargent in a portrait taken by Horace McFarland, c. 1904. The correspondence between the two was warm and mutually supportive. In a letter of 8 April 1905, André wrote, "I have just received your beautiful and useful volume,* Manual of the Trees of North America, *and I'm sending you right away my thanks and compliments, before speaking of it in the* Revue Horticole. *You have known for a long time how much I admire your inexhaustible creativity."*

collecting trip to South America, a trip that took two years and resulted in 3,400 specimens being sent back to Paris. His travels also took him to Russia, the Mediterranean, Turkey, and the United States. He amassed a personal herbarium of thousands of specimens, meticulously labeled and maintained. At his country home in Lacroix where he spent his summers, he developed an experimental nursery and arboretum. He was an expert on bromeliads and the genus *Andrea* of the Bromeliaceae was named in his honor. He published numerous plant profiles, articles on plant culture, and several monographs on his botanical explorations.

Born in Bourges, France, the son of a nurseryman, André apprenticed for a year with the municipal horticulturist of Angers and finished his education in Paris, studying for a year at the *Muséum d'Histoire Naturelle.* In 1860, at the age of twenty, he was named head gardener *(Jardinier Principal)* of the city of Paris by Adolphe Alphand, the chief park designer for Haussmann. With this position André joined the team that implemented Alphand's designs, which transformed Paris from a sprawl of disconnected enclaves into a model of monumental city form that sparked international interest. The new parks and boulevards of Paris were on the itinerary of every tourist,



André's design for Sefton Park in Liverpool included a botanic garden, seen in the plan above. (From André's L'Art des Jardins.*)*

student, and landscape professional who embarked on the Grand Tour. André worked with Alphand on the Bois de Vincennes, the Bois de Bologne, and the Parc Montsouris, but his reputation today rests on his work on the Parc des Buttes-Chaumont, the crescent-shaped strip of land in the northeast quarter of Paris. It was molded from a municipal dump and gallows site into a park of dramatic topography, deliberate rusticity, and romantic symbolism. André was responsible for the planting of the site, a complex project because of the variety of environments—rock escarpments, water edges, woodland, open meadow.

André's approach to planting design has often been compared to Olmsted's. The similarities are there: a reliance on rich foliage texture, a sense of appropriateness, and a suspicion of anything decorative or overly manipulated. Like Olmsted, André believed that landscape improvements elevated human morals, and he used the "ill-famed" reputation of the Buttes-Chaumont site as an example.

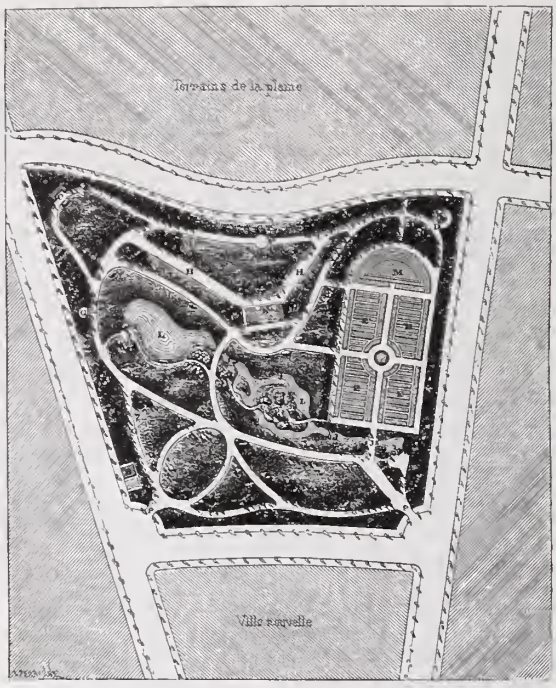
In 1866, André won a competition for the design of a large public park in Liverpool, England, to be built on land given to the city by Lord Sefton. Sefton Park emerged as a project of urban design not unlike those Olmsted was tackling in the United States. André was responsible not only for the parkland but for the adjoining boulevards and building lots. The Sefton Park project, which took ten years to complete, allowed him to set up a private office in Paris, and in subsequent years of professional practice he designed parks and gardens all over the world. The list is staggering. It includes Woodhouse Moor Park in Leeds; the park of Count de Friese in Friesenborg,

Denmark; the garden of Count Orloff-Davidoff in Russia; the parks of Prince Liechtenstein and Baron Nathaniel de Rothschild in Austria; as well as many private gardens in France. André enjoyed his wealthy clients and shared with Sargent the conviction that they alone allowed him to display his artistic aptitude.

All the same, a large part of his practice was taken up with public parks. He transformed the Citadel of Luxembourg into a large public garden and the public gardens of Monte Carlo into a grand showcase of tropical plants. Sargent praised the latter gardens in a short article in *Garden and Forest* (April 29, 1891) for the skill and refinement with which André treated this important waterfront site. In Holland he managed the reconstruction of two seventeenth-century gardens, Welham and Amerongen, and their conversion into parks for the public. He worked in Rome, refining plans for the Piazza Bianca and the Quirinal and working with Roman designers to transform the gardens of the Villa Borghese from a private garden into a public park. André also prepared plans for the redesign of Montevideo in Uruguay, predating his countryman Jean-Claude Nicolas Forestier's urban design work in South America by some twenty years.

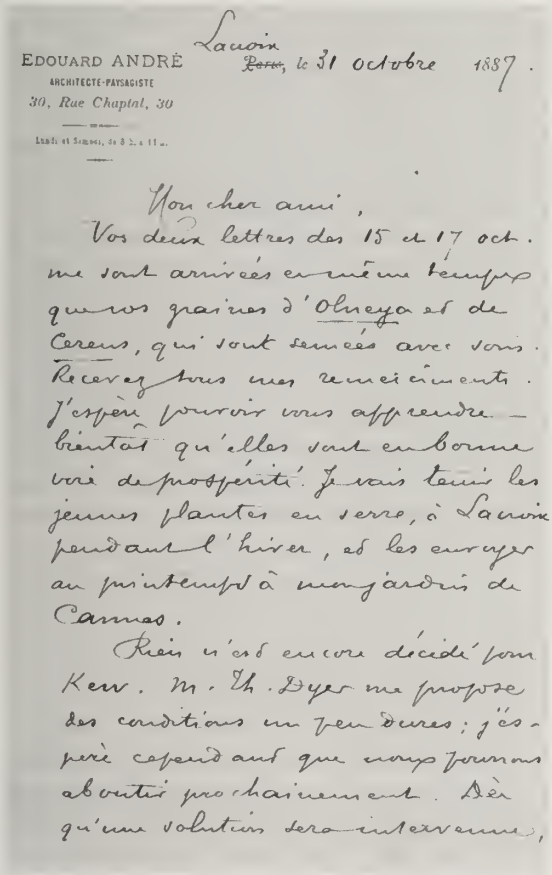
The André letters to Sargent center on Sargent's decision to have the plates of his ten-volume *Silva of North America* (1890–1902), which were drawn by Charles Faxon, engraved in Paris. He requested André to find an engraver and to supervise production. The details of these transactions form the heart of the letters. If the business details are routine, the subtext of André's measured diplomacy, mediating between a temperamental French engraver and a demanding and parsimonious American client, makes for amusing reading. Nonetheless, André felt honored to assist Sargent with the project.

"You also know that I am not insensible of the very natural feeling of pride created in me by your choice of our country to prepare the illustrations of your great work. It will soon be a century since my compatriot André Michaux published his beautiful studies on American dendrology [*North American Sylva,* 1810–1817]. I congratulate you on having resumed and rebuilt his work on such a grand scale, with all the resources that botanists—your compatriots and others—have accumulated over three quarters of a century, and after having made broad advances in the works of your predecessors by your personal contributions to the knowledge of North American flora" (André to Sargent, 2 March 1887).



André transformed the Citadel of Luxembourg into a large public garden. Part of his scheme of 1871 was a botanic garden dedicated exclusively to native flora. André's idea, which he believed to be novel, was to present a complete living display of the flora of Luxembourg's fields, woods, meadows, and crags that would acquaint the public with their names, botanical classification, uses, and ornamental qualities. (From L'Art des Jardins.*)*

André edited *L'Illustration Horticole* from 1870 to 1880 and the prestigious *Revue Horticole* from 1882 until his death. He was sympathetic to Sargent's tribulations as editor of *Garden and Forest* and contributed regular short pieces on developments in French horti-



EDOUARD ANDRÉ
ARCHITECTE-PAYSAGISTE
30, Rue Chaptal, 30
Lundi et Samedi, de 8 h. à 11 h.

Lacroix, le 31 octobre 1887.

Mon cher ami,

Vos deux lettres des 15 et 17 oct. me sont arrivées en même temps que vos graines d'Olneya et de Cereus, qui sont semées avec soin. Recevez tous mes remerciements. J'espère pouvoir vous apprendre bientôt qu'elles sont en bonne voie de prospérité. Je vais tenir les jeunes plantes en serre, à Lacroix pendant l'hiver, et les envoyer au printemps à mon jardin de Cannes.

Rien n'est encore décidé pour Kew. M. Th. Dyer me propose des conditions un peu dures; j'espère cependant que nous pourrons aboutir prochainement. Dès qu'une solution sera intervenue,

Lacroix, 31 October 1887

My dear friend,

Your two letters of October 15 and 17 reached me at the same time as your Olneya and Cereus seeds, which have been carefully planted. Accept my thanks. I hope soon to be able to let you know that they are prospering. I am going to keep the young plants under glass at Lacroix during the winter, and send them in the spring to my gardens at Cannes.

Nothing has yet been decided for Kew. M. Th[iselton-]Dyer is proposing rather hard conditions; I nevertheless hope that we will be able to conclude things soon. As soon as we have a solution, I will answer you about the collection for the herbarium at Harvard University. I would be happy to know that one of my collections will be part of the herbarium at that wonderful institution.

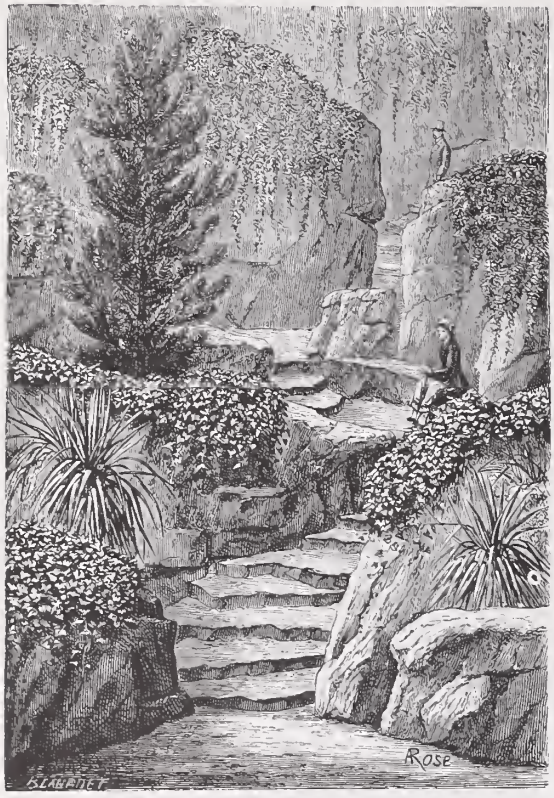
We will return to Paris the 4th of November to take up winter residence. As soon as I arrive I will see to the trees and shrubs that you want to obtain from the City of Paris, and I hope to be able to send them to Waterer very soon, following the instructions that you gave me.

If, from your side, you send something to England, I would like to request that you add some grafts or a young specimen of a new variety of plum tree that is being much talked about in the United States. It is the Japanese Kelsey Plum. They are found at Bruckman's, in Augusta, and elsewhere, I believe.

I am sending you along with this letter some seeds from a new Cotoneaster *brought from China by Abbé David, which I am cultivating under the name of* C. horizontalis *Decaisne. It is the prettiest plant that I know of for rocks, and I have a specimen at Lacroix that is really the prettiest thing one could ever see, with its purple leaves and its scarlet red fruits. It has the habit of* C. *of the section* Microphylla *with the fruits of the section* Nepalensis. *Perhaps you already have this species, which however is not widely disseminated and almost unknown in France.*

Please remember me to Professor Gray, and do the same with Olmsted.

And believe that I remain, my dear friend, your very devoted and affectionate.....E. Andre.



André ornamented this picturesque path in Parc des Buttes-Chaumont with a variety of lush vegetation. In L'Art des Jardins, *he noted that if the rocks were arranged with taste, in a natural way, this treatment could serve as a model for similar scenes in hilly parks and gardens.*

culture, but he was not above a bit of frank criticism: "Your journal becomes better with each day, and it contains a quantity of original material of the highest quality. I am happy to give you my compliments on it. But it is too "high class"; with your American habits of abundant information, you should perhaps have more text concerning ordinary efforts in horticulture and the choice of ordinary plants" (André to Sargent, 14 July 1888).

Apprenticeship was the accepted form of training for the young field of landscape architecture in the late nineteenth century, before university degrees were offered. André's Paris office was open to a number of Sargent and Olmsted protegés. Henry Codman, Sargent's nephew, spent a year in André's office before returning to the United States to join Olmsted's office. Charles Eliot, traveling in Europe in 1886, spent time with André, who guided him to key parks and gardens in Paris and explained his business practices. André offered hospitality to Sargent's daughter Harriet on her honeymoon trip to Paris with her young husband, the architect Guy Lowell. He appears to have grown very fond of the "young Lowells," as he called the couple, who often visited the André family at their summer home in the Loire.

André became the official host to an expanding circle of acquaintances passing through Paris. He was generous with his time, arranging itineraries through the French countryside with the attention of a personal travel agent. A detailed trip through the Loire that he prepared for Olmsted during his 1892 visit to France included several private chateaux in Orleans and the Garden of Louis XII at Blois. In Tours he recommended the public garden and the Jardin des Plantes with its fine collection of conifers. He also recommended a visit to M. Manse's residence at Les Bouches, where André "took Professor Sargent and some other American gentlemen."

André's friendship with Olmsted dated back to André's trip to New York in 1876. After being introduced through a mutual acquaintance, Olmsted arranged a large dinner for André at Delmonico's to introduce him to his co-designer of Central Park, Calvert Vaux, and other colleagues. Olmsted then drafted an itinerary for André's visit to the United States, which is a revealing summary of Olmsted's preferences in landscape design at the time.

In Philadelphia Olmsted recommends—"besides what is a matter of course"— Cypress Hill Cemetery and Bartram's Garden; in Washington D.C., Georgetown Cemetery and the Soldier's Home; in Baltimore, Druid Hills

Park; in Cincinnati, Spring Grove Cemetery; in Chicago, the park laid out by Professor [William Le Baron] Jenney and another rearranged horticulturally by Mr. [Horace W. S.] Cleveland. He recommends a day in Buffalo to see Goat Island but warns that in leaving Niagara the scenery is interesting but "rather triste" (Olmsted to André, 16 August 1876, draft).

André's relationship with Olmsted has rich potential for further research. Theirs was a more formal relationship, perhaps because of age differences; Olmsted was born in 1822 whereas Sargent was born in 1841, only one year after André. From the André correspondence to Sargent, it seems that Olmsted was a source of constant speculation among his friends and colleagues, not unusual for a man of great accomplishment and influence.

"I was much struck by what you said about Olmsted, that he was drowning in an infinity of details instead of having assistants who could take care of that for him. . . . It seems that one becomes more difficult and more meticulous as one gets older, and that more and more one takes one's inspiration from the English proverb: 'Triflers make perfection, and perfection is not a trifle.' What one should do, by contrast, is to look only at the large lines and get rid of the small ones (André to Sargent, 12 January 1894).

More poignant was André's indirect advice to Olmsted in the same letter: "When you see Olmsted, give him my best wishes. Tell him

The Virtues of Neglect

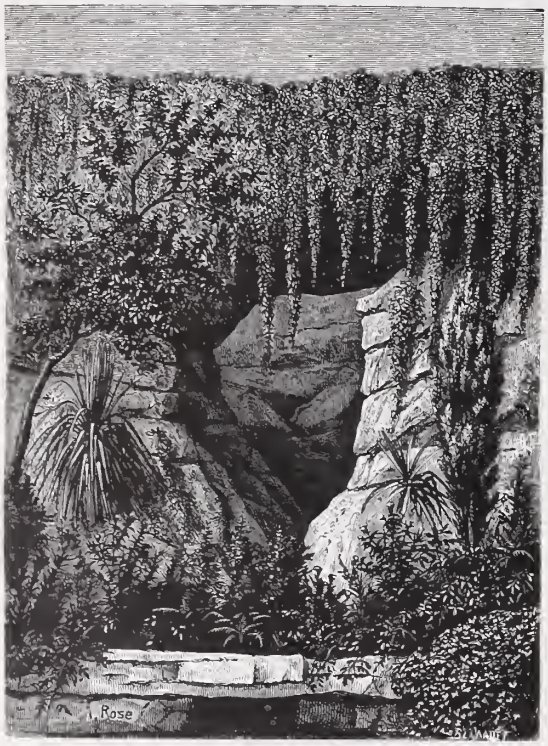
In 1882, reflecting on Central Park in "Spoils of the Park," Frederick Law Olmsted drew on an experience with Edouard André in Paris.

Neglect for considerable periods may do no serious permanent harm. . . . Neglect, if it continues not too long, may even have its advantages. The landscape-architect André, formerly in charge of the suburban plantations of Paris, was walking with me through the Buttes-Chaumont Park, of which he was the designer, when I said of a certain passage of it, "That, to my mind, is the best piece of artificial planting, of its age, I have ever seen." He smiled, and said, "Shall I confess that it is the result of neglect? I had planted this place most elaborately, with a view to some striking immediate effects which I had conceived, and others, to be ultimately obtained by thinnings. I had just worked out my plan, when the war came; and for two years I did not again see the ground. It was occupied as a camp; horses were pastured in it; it was cut up by artillery; fires were made in it. As a park, it was everywhere subjected to the most complete neglect. When, at length, I came back to it, expecting to begin my work over again at all points, Nature had had one summer in which, as well as she could, to repair damages; and I declare to you, that, on arriving at just this point, I threw up my hands with delight, for, spite of some yet unhealed wounds, I saw at once that in general aspect there was a better work than I had been able to imagine. That which was weak and unsuitable in my planting had, by natural selection, disappeared; and in the struggle for existence nearly all that remained had taken a wild character, such as in an art we may aim at, but can hardly hope to attain." (But see how the true artist at once bowed himself before his tutor, and recognized and seized the opportunity.")*

* From *Forty Years of Landscape Architecture: Central Park*, edited by Frederick Law Olmsted, Jr., and Theodora Kimball. Cambridge, MA: The MIT Press (1973), 144.

that right now is the time for him to prepare a great work, well illustrated, in which he expounds on his theories of the art of the garden, bolstered by examples of his personal creations. This is what I would like to see soon. He is rich; he can give himself this satisfaction. As soon as I can, I will do the same . . ." A year later Olmsted's last illness required that he be permanently hospitalized at McLean's Hospital in Belmont, Massachusetts.

André's own great work was *L'Art des Jardins,* published in Paris in 1879. It was a work of grand scale, a compendium of garden history, technical guidelines for construction, and esthetic standards. It included plant lists for specific settings and was profusely illustrated with eleven chromoliths and two hundred fifty wood engravings. It was André's attempt to codify landscape design and to describe in a workmanlike manner the techniques available to accomplish a transformation of landscapes on a grand scale. The only portion of *L'Art des Jardins* to be translated into English was Chapter Seven, "A Division and Classification of Parks and Gardens," which was published in *Park International* in July of 1920. This section was André's attempt at a typological description of landscapes, by size, by land use, by historic precedent. His need to classify seemed most appropriate for a late nineteenth-century treatise by a designer/horticulturist. The chapter served as an excellent introduction of André's work to American readers. It displayed the precision and clarity of his thinking and his theory of appropriateness of design to site conditions and natural character. Olmsted was so impressed with the book that he offered to help André find an American publisher and act as the American editor, but this appears not to have happened.



A rockwork ravine in Parc des Buttes-Chaumont is planted in Virginia creeper (Parthenocissus cinquefolia) *and other climbing plants. (From André's* L'Art des Jardins.*)*

The reputation of Edouard André rests on his ability to codify the *style composite,* the overlay of the *jardin anglais* on the French formal style. This hybrid of English pastoralism within an architectural frame was refined by Adolphe Alphand in his designs for the parks of Paris. André's contribution was a lush planting style based on horticultural appropriateness enhanced by the introduction of compatible exotic species, a practice that aligned him with Olmsted and his followers. Critical opinion has not rendered André as an original thinker but as a strong spokesman for the French interpretation of the pastoral style. His writings, his teaching, and his professional comportment influenced a generation of young practitioners, both French and American. When Charles Sprague Sargent dedicated the tenth volume of his *Silva of North America* to André—"Artist, Explorer, and Student of Plants"—it was not a simple payback for handling the often frustrating negotiations with French engravers but as a gesture of

NEWS

from the Arnold Arboretum

Indonesia Supports Major Program for Biodiversity Conservation

Robert E. Cook, Director

August brought us wonderful news for the Arboretum. We have been awarded $2,375,000 from the Government of Indonesia for a five-year contract to provide technical assistance as part of a $12,000,000 project to increase the capability of Indonesian scientists and government agencies to conserve the country's biodiversity and manage its natural resources. Dr. John Burley of our staff has assembled an international team of experts drawn from Harvard University, London's Natural History Museum, the National Museum of Natural History, and the Rijksherbarium of the Netherlands, and the Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia. The Arboretum is the lead institution in this collaborative effort, which is being funded by the World Bank through a program it manages called the Global Environment Facility (GEF).

Indonesia contains 10% of the world's tropical forests and is second only to Brazil in the richness of its fauna and flora. Many sectors of the economy are dependent upon the sustainable management of these resources. Yet 30% of the flora and 90% of the fauna are not fully described or scientifically documented. Indonesia's ability to maintain and enhance knowledge of its biodiversity is severely limited by a shortage of trained staff with expertise in botany and zoology, by inadequate storage and research facilities, by deteriorating zoological and botanical collections, and by a lack of modern computer technology and a system for information management.

With the Biodiversity Collections Project, the Arboretum will create an international model for biodiversity conservation through technical assistance to a developing country. This assistance will provide support for the restoration and development of zoological and botanical collections, the creation of biodiversity databases, and the training of Indonesian scientists in botany, zoology, information management, and resource conservation.

I believe this project will place the Arboretum in a clear position of future leadership in Asian systematic biology. More importantly, it will directly address the threat of species extinction and the loss of tropical biodiversity in the most fundamental way possible: by helping the Indonesians themselves to protect their environment and prudently conserve their natural heritage through the development, management, and wise use of knowledge about the fauna and flora of their country.

Andrew MacDonald

An Indonesian botanist collecting a specimen of *Finschia* (Proteaceae), a canopy tree of the lowland tropical forest.

Boston Teachers Learn Arboretum Science

Richard Schulhof, Assistant Director for Education and Public Affairs

The need to better educate our children about science is well known, but education reformers are just discovering that much of the needed change must begin with teachers. Across the country, school systems are working not only to enhance the scientific knowledge of teachers but also to provide training in the inquiry-

Karen Madsen

Boston teachers who participated in the Arboretum's science education workshop pose for a class photo. Diane Syverson, Arboretum school science program manager, is on the far right.

based teaching methods that can succeed in engaging children in science learning. Yet in our larger cities this can be a daunting task. With only limited resources and under the pressures of urban classrooms, how can teachers increase their knowledge as well as reshape their teaching? In the Boston area, Arnold Arboretum summer workshops are proving to be at least a small part of the answer.

This past July the Arboretum hosted twenty-six teachers for an intensive two-week workshop led by school science program manager Diane Syverson and instructors Debbie Knight and Helen McElroy. Supported by a grant from the Dwight D. Eisenhower Math and Science Education program, the goal of the workshop was to provide advanced training for teachers from schools in Dorchester, Jamaica Plain, Hyde Park, Roxbury, and other nearby Boston communities.

All participating teachers were alumni of previous Arboretum workshops, thus permitting the group to hit the ground running with a particular emphasis on how living plants can be used to involve students in the excitement of actual scientific observation, questioning, and discovery. In the Arboretum landscape teachers examined "weeds" that can be found near the schoolyard and used for life science explorations, while indoors they conducted seed experiments that serve as models for scientific investigation.

As the workshop drew to a close, both project staff and teachers looked forward to continued learning during the school year through meetings at the Arboretum and classroom visits from Arboretum staff. In the words of one teacher, "I have discovered many new ways to use the Arboretum as a resource. . . . I expect plant science to take off in my classroom." With planning underway for next year's workshop, plant science may be taking off across the Boston Public School system.

Arboretum Open House, Sunday, October 16

Join Arboretum staff for a special open house welcoming members of the Friends of the Arnold Arboretum and the larger Boston community. Scheduled to run from 2:00 to 4:00 pm, the event will feature tours of the landscape, greenhouse, and Hunnewell Building and offer opportunities to chat with Director Bob Cook and other staff about Arboretum plans and programs. Please mark your calendars. We look forward to seeing you this October!

The Library Is Back

Sheila Connor, Horticultural Archivist

Among my friends there are a few who, while otherwise quite mature and respectable, are intimidated by libraries. I know this because they often confide in me, expecting, I am sure, a certain amount of sympathy. Unfortunately, very little is forthcoming for this is an affliction that I simply cannot understand.

There is nothing like a library, and there are no two libraries that are alike. I can walk into one anywhere, and even if the classification scheme is unique and the titles are in a foreign language, I instantly feel a sense of order, stability, and security. I feel at home. That probably explains why throughout the year of our recently completed renovation of the Hunnewell Building I felt more than displaced, I felt lost. On occasion I found myself concocting any kind of excuse that would enable me to use another library. I not only missed what was inside the books, I missed how they looked and how they felt. I even missed how they smelled. (No, not that damp musty odor of books stored too long in the basement, just that slight hint of leather and library paste.)

The Arnold Arboretum's library—books, journals, pamphlets, photographs, glass plates, maps, files, bindery equipment, and a good part of the archives—were packed up and shipped off for the duration. It is no mean feat to move a library. The classification sequence of the monographs and the organization of the journals must not be disturbed. In fact, *everything* must remain in order or chaos will reign upon its return. Although we came up with a scheme that allowed each shelf of books to be removed and stored in strong, ridged, sealable crates that would not only keep the books and the journals in order but would protect them during their year in limbo, there always loomed the possibility that a crate or crates would be misnumbered or somehow go astray. Moreover, it was also possible that I had mismeasured the amount of new shelving needed even though I measured and figured it at least four ways from Sunday. Or worse yet, because the library was going to be rearranged, I may have totally miscalculated absolutely everything. So although I had missed the library sorely, you can understand that it was with both anticipation and genuine fear that I welcomed it back.

I am delighted to report that it fit. And through the combined efforts of an able assistant, the staff of the Botany Libraries, volunteers, summer interns, and a dedicated library committee, the library is now in better order than it was before the renovation occurred. Its setting has been so improved that now the quality of its surroundings matches the value of its content. With new lighting and paint, refinished floors, tables, and a whole range of appropriately sized new shelving, the library is better appointed than it was in 1892 when the Hunnewell Building first opened. I can say this with no disloyalty to Charles S. Sargent, the Arboretum's first director, nor to Longfellow, Alden and Harlow, the building's original architects. Of course, the climate control that we now have in the library and throughout the building had not yet been invented, but it would appear that Sargent had an innate fear of electricity (and perhaps of natural gas as well) for the Hunnewell Building was not lighted until after his death in 1927.

I should allay any fears that those familiar with the library

Karen Madsen

In May the Arnold Arboretum held a special event honoring the memory and accomplishments of Donald Wyman, Arboretum horticulturist from 1935 to 1970. Pictured here with a portrait of Dr. Wyman are Donald Wyman, Jr., and Donald Wyman Thomas.

might have concerning changes in its ambiance. The beautiful reading room—with its grand oversized table and walls of windows that allow a glimpse of the living collections, as well as the wonderful corridor space and alcoves with wooden shelving that extends all the way up to the high ceiling—looks brighter and cleaner but otherwise exactly the same. (Well, we do now have a whole complement of Harvard chairs around that wonderful table.) The most dramatic, and welcome, change has come in the stacks, the part of the library housed in the herbarium wing. Gone are the dark-green jerryrigged, recycled stacks that were shimmed to the ceiling and in constant danger of letting go. All have been replaced with light-colored metal shelving that is sturdy and stable, sized to fit oversized books and archival boxes as well as journals and monographs. Now that the atrium has been reopened—and glassed in on the library level—the core of light that passes through the center of this room imparts an extraordinary feeling of openness. We have also added something new, a special laboratory, a room set aside, dedicated and outfitted for the care and repair of books.

As for the content of the library, we have developed a mission statement—it is to provide and maintain a collection of scholarly materials on North Temperate Zone woody plants in support of the curatorial, research, and educational programs sponsored by the Arnold Arboretum. Thus the library reflects the Arboretum's mission and, through its holdings in botany, horticulture, and related fields, supports its curation. With a collection whose range includes books and periodicals on arboreta and botanic gardens, botany and horticulture, and North Temperate Zone floras in general, plus monographs on North Temperate Zone plants, dendrology, ecology, forestry, landscape gardening, seaside plants, hedges, screens, and windbreaks (just to name a few), the library is in my estimation—and I think that those who have used it would agree—the best library in the nation, if not the world, dedicated to understanding, identifying, and growing woody plants.

So we are back to purchasing books and checking in journals. There is one other thing. There has been, for me, an unanticipated benefit derived from the renovation. The library is back in place, but it's not back in exactly the same the place—everything has been shifted. So now when I walk through the stacks to retrieve a book I can no longer depend on rote; I now see titles that I once overlooked. The benefit is that I've discovered a whole library of new books.

Arboretum Assists Brookline Tree Inventory

Chris Strand, Outreach Horticulturist

The word is getting out about the long-term savings that can be achieved by planting trees in cities and suburbs. Trees make it less costly to heat and cool buildings; they absorb air pollution and provide a wide range of other environmental benefits. An article in last April's *New York Times* described how the planting of 95,000 trees would reap an estimated net benefit of $38,000,000 over thirty years. This sort of cost-benefit analysis is prompting local communities to take a serious look at their urban trees.

This past spring the town of Brookline, working with the Arnold Arboretum, the University of Massachusetts, and the Brookline Greenspace Alliance, organized an inventory of its street trees as a first step toward managing its urban forest. Instead of sending professional arborists to complete the inventory, a process that can be prohibitively expensive, the town decided to organize teams of volunteers. Ninety-two volunteers signed up and agreed to participate in the five-day project.

On the first day of the project volunteers came to the Arnold Arboretum for a six-hour training session. As part of their training, volunteers learned to measure the DBH (diameter at breast height) of a tree, assess its condition, and iden-

Amy Wilson

Use of the Arboretum's living collections for horticultural education is an ongoing focus in the work of outreach horticulturist Chris Strand.

tify its pruning needs. In addition, Richard Schulhof and I volunteered to use the Arboretum's collections to teach the volunteers how to identify 23 common street trees. At the same time, we taught them how to use a dichotomous key.

On the remaining four days of the project the volunteers walked through the neighborhoods of Brookline measuring, assessing, and identifying trees. Project organizers were pleasantly surprised that each team of three volunteers completed an average of 250–300 trees per day. All totalled, the volunteer force inventoried 101 miles of roadway over the two weekends. Preliminary results indicate that Brookline has over 11,000 street trees (not including trees in yards or in parks). Using the data the volunteers collected, the University of Massachusetts will create a map and database to help the town develop management strategies for the trees.

On the Grounds

Peter Del Tredici, Assistant Director for Living Collections

For the Living Collections Department, staff, grounds crew, and interns alike, the summer of 1994 has been the summer of Peters Hill. Our renovation project began last autumn when, with the support of a grant from the Institute of Museum Services, former intern David Giblin was hired to review all of the plantings on Peters Hill. This spring, with David's recommendations in hand, the process of plant removal began with specimens that were diseased or in poor condition or were deemed superfluous to the scientific needs of the Arboretum. In all, some 3,000 plants were evaluated, resulting in approximately 150 removals and 100 relocations of plants from Peters Hill into the core collections area on the other side of Bussey Street. Following

Peter Del Tredici

Don Garrick of the grounds crew helping to convert the Peters Hill dump into the Peters Hill recycling center.

these deletions, many of the remaining trees were pruned (for the first time in years), and invasive vines that had climbed into the crowns of many of them were removed. All of this work, of course, is preparatory to replanting Peters Hill with a new generation of collections-quality plants, which is scheduled to begin in the spring of 1995. Planning for this replanting was instituted this past spring and will be finalized over the coming winter. We hope to present the plan to readers of *Arnoldia* in an upcoming issue.

Less obvious than the work on the plantings, but no less important, was the completion of the clean-up of the "dump" on Peters Hill, located in the old stone quarry along Bussey Street. This monumental job, which actually began a year ago, was coordinated by superintendent Pat Willoughby with assistance from grounds crew member Don Garrick. With ancient mountains of brush reaching some 30 feet in height, the job was the Arboretum equivalent to

Karen Madsen

This past spring and summer the Arnold Arboretum Committee worked with Waste Management, Inc., City Year Corps members, and other volunteers on highly successful cleanups of Arboretum perimeter areas. The Arboretum's Jim Gorman is seen here (lower left) with members of the Massachusetts Horticultural Society's Green Team. Many thanks to all for a job well done!

the cleaning of the Augean stables. Construction as well as arboreal debris had been dumped there for countless years, and all of it had to be processed, sorted, and screened before it could be reused or hauled away. Stones were set aside for future construction projects, brush was ground up into woodchips, and metal and stumps were hauled off in 30-cubic-yard dumpsters (14 of them). The end result of all this effort was a tall mound of screened loam and another of woodchips that will be used to help future plantings off to a good start. As a final touch, a new gravel road was installed in the quarry, giving access to the area from above as well as from below. In effect, this project has transformed an old dump into a new recycling center where we will reprocess the massive amounts of woody debris generated by the living collections.

NEA Awards $25,000 for New Arboretum Program

The National Endowment for the Arts has awarded $25,000 to the Arnold Arboretum to introduce the study of landscape and landscape architecture as a new multidisciplinary subject for Boston-area classrooms. The program will be developed as part of the Arboretum's collaboration with the Frederick Law Olmsted National Historic Site in Brookline.

Called Junior Parkmakers, the program will center on an Arboretum field trip complemented by activities and teacher's guide materials designed for classroom use. With an emphasis on outdoor exploration, program activities will seek to examine the landscape as a part of the human environment that can be understood from scientific, aesthetic, and social perspectives. The program will be developed in consultation with Boston area teachers and will be designed to address curriculum goals in science, the arts, and social studies. Pilot testing of the new field study is scheduled to begin in the fall of 1995.

Programs & Events

The Arboretum's Education Department offers a wide variety of courses, programs, and lectures in horticulture, botany, and garden history. Come to the Arboretum this fall to study such diverse topics as tree identification, year-round garden maintenance, and horticultural writing. A selection of fall courses is shown here. For a complete catalogue of programs and events at the Arboretum, please call (617) 524-1718, ext. 162. Please note that fees shown in boldface are for members of the Arboretum. For information about becoming a member, please call (617) 524-1718, ext. 165.

ART 420 Horticultural Writing Workshop

Kim E. Tripp, Putnam Fellow, Arnold Arboretum

This new course will offer a hands-on opportunity to learn the ABCs of horticultural writing and publication. Students will explore creativity and technique through a series of reading and writing exercises and roundtable discussions. Horticultural references and computer resources will be illustrated. The class will discuss the range of publication opportunities for new authors and learn how to submit ideas to specific publications. Students can choose to be guided through the process of initial submission of a finished piece to an appropriate gardening publication. Limited enrollment.

Fee: $96, $110

6 Tuesdays, October 4, 11, 18, 25, November 1, 8/ 1:30–3:30 pm (Hunnewell Building)

An Arnold Arboretum course offered in cooperation with the New England Wild Flower Society.

WAL 273 Arnold Arboretum Landscape Architects and Designers Discussion Series

On three Thursday evenings in October, some of New England's most highly respected landscape architects and designers will present their work and design philosophy. Each will illustrate his or her projects with slides, and explain the rationale and constraints that affected the outcome of the projects under discussion.The three architects and designers represent a range of design opinion, and the work shown in the series will encompass public, residential, and industrial projects.

In an informal discussion period following the lecture, audience members will be able to ask questions and further explore the thinking of the architect or designer.

WAL 270	Carol Johnson	October 13
WAL 271	Michael Van Valkenburgh	October 20
WAL 272	Susan Child	October 27

WAL 273 Series Fee: $40, $46
Single Lecture Fee: $15, $18
3 Thursdays, October 13, 20, 27/ 7:30–9:00 pm (Hunnewell Building)


Margot Balboni

Photographers Elise Laurenzi and Ken Druse discuss a scene.

ART 412 Landscape Photography Workshop

David Akiba, Photographer

This workshop will explore both technical and aesthetic approaches to color landscape photography using the peak of fall foliage color in the Arboretum as our laboratory. The Saturday class will begin in the Dana Greenhouse with a brief lecture and discussion of materials and equipment, and will be followed by a photographing field trip through the Arboretum. A critique on Tuesday evening will examine each student's work, technically and visually. Participants will be encouraged to investigate new and more personal ways of rendering the colorful panorama of fall in the Arboretum. An equipment list will be sent on pre-registration.

Fee: $83, $92
Saturday, October 15/ 9:00 am–4:00 pm (Dana Greenhouses and Arboretum grounds) and Tuesday, October 18/ 6:30–8:00 pm (Dana Greenhouses)

HOR 264 Landscaping with Herbs: A Morning with Jim Wilson

Jim Wilson, Co-host of The Victory Garden *and Horticultural Writer*

In researching his latest book, *Landscaping with Herbs,* Jim Wilson traveled to all corners of the United States to photograph the latest uses of herbs in garden landscapes of all sizes and styles. Jim will show slides of these wonderful gardens and talk about the newest and best herbs for landscaping, culinary, and craft uses. On the practical side, he will discuss the importance of soil preparation for herb culture and the long-term maintenance of herb gardens. Jim Wilson is known to the audience of *The Victory Garden* as the popular co-host; he is also a prolific garden writer and lecturer with several books to his credit.

Fee: $14, $18
Saturday, November 5/ 10:00 am–noon (Hunnewell Building)

Co-sponsored by the Arnold Arboretum, Massachusetts Horticultural Society, the New England Wild Flower Society, and the Worcester County Horticultural Society

HOR 459 Multi-Season Perennials, Shrubs, and Trees Hardy in New England

Galen Gates, Chief Horticulturist, Chicago Botanic Garden

Many of the hardiest plants for New England are also star performers in the Midwest, where Galen Gates grows and evaluates them for the Chicago Botanic Garden. His plant enthusiasms are many, and he will introduce herbaceous and woody plants that are tough enough for the cold and wind of the Midwest, and therefore make fine candidates to try in New England.

Fee: $12, $14
Thursday, November 10/ 7:30–9:00 pm (Hunnewell Building)

BOT 249 The Sex Life of Plants

James Martin, Botanist and Horticultural Instructor

Over eons of time, plants have evolved reproductive strategies of great precision. Many angiosperms have developed complicated biochemical pathways to produce the bright colors and exotic perfumes that attract specific insect pollinators. The basic biology of reproduction in plants will be covered in this course, which is designed to meet the needs of gardeners and plant propagators.

Fee: $48, $54
3 Mondays, November 28, December 5, 12/ 6:30–8:30 pm (Dana Greenhouses)

Rare • Unusual • Exotic

ARNOLD ARBORETUM
12th Annual Plant Sale, Auction and Members' Bonus
Sunday, September 18, 1994

at the
Case Estates
135 Wellesley Street
Weston, Massachusetts
For more information and plant sale catalogues, call (617) 524-1718

Plant Sale	10:30 A.M. - 2:00 P.M.
Silent Auction	11:00 A.M. - 12:30 P.M.
Plant Society Sales	9:00 A.M. - 2:00 P.M.

Members receive bonus plants and discounts beginning at 9:00 A.M.

friendship, an acknowledgment of André's valuable contribution to the world of horticulture and design.

Acknowledgments

The author would like to express gratitude to Mary Jane Kaplan for her translation of the André letters and to Charles Beveridge, the series editor of the Frederick Law Olmsted Papers, for sharing a portion of the André/Olmsted correspondence.

Bibliographic Note

Information about the life and work of Edouard André is scattered among the publications of landscape design history and horticulture, with the one field not fully recognizing his accomplishments in the other. Volume 42 (1895) of *The Garden* (London) was dedicated to André and a short introductory essay in that volume describes his life and work to that date. Two memorial articles written at his death give the best documentation of his accomplishments: *Gardeners' Chronicle* (11 November 1911) and *Revue Horticole* (1 Novembre 1911). Dorothée Imbert in her book, *The Modernist Garden in France* (New Haven: Yale University Press, 1993), gives an excellent summary description of André's contribution to French landscape design within the context of the precursors to modernism.

Phyllis Andersen is landscape historian at the Arnold Arboretum.

André included this illustration of Calvert Vaux's mushroom kiosk for Central Park in his L'Art des Jardins.

The dense and uniform inflorescences of a plant of Cotinus coggygria *grown at the Arnold Arboretum from seed collected on the north slope of the Caucasus Mountains during the 1980 expedition to Russia (Karen Madsen).*

Considering *Cotinus*

Kim E. Tripp

"I was spellbound by the combination of the prunus and sumach* [Cotinus] *painting the hillsides with bold bands and splashes of fiery orange and red . . . it created an unforgettable picture . . ."

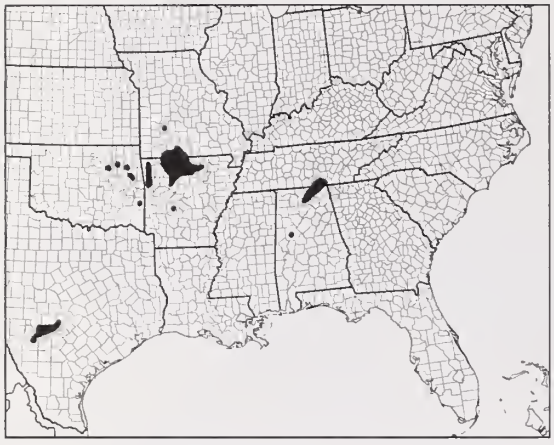
Like Roy Lancaster marvelling at the combination of a cherry and a smokebush near the Great Wall of China one autumn, I was spellbound myself by an exceptional plant of *Cotinus coggygria* (smokebush, smoketree, or Venetian sumac) creating a billowing cloud of "smoke" along Meadow Road at the Arnold Arboretum. It was amazingly dense and uniform, with surprisingly simultaneous development of its inflorescences throughout the canopy. Inspection of its label revealed that this notable *Cotinus* was a seedling grown from wild-collected seed, and a little digging through the Arboretum's records told me that the seed was brought back from Mt. Maschuk above the city of Pyatigorsh during the Arboretum's 1980 expedition to the then USSR. What a striking sight it made with its light pink smoke dramatically framed by the deep burgundy foliage of a nearby Japanese maple.

The drama and appeal of this plant set me to thinking about this interesting genus and to wondering why, even though it has been in cultivation since at least the mid-seventeenth century, plants such as this exceptional seedling are not used more widely in landscapes and gardens. After all, *Cotinus* is a well-known genus of lovely summer-flowering, deciduous shrubs or trees of limited size. Members of the genus are pest and disease resistant, drought tolerant, and relatively cold hardy. They thrive in a range of soils, and most can be vegetatively propagated. Plus, there is a handsome, native species. Add its multiseason interest, and it begins to seem like a perfect plant for the modern landscape.

The genus *Cotinus* is a member of the Anacardiaceae, or cashew family, and as such is botanically related to the sumacs *(Rhus)* and our familiar poison ivy *(Toxicodendron radicans);* but *Cotinus* only rarely causes dermatitis and, unlike poison ivy, is not invasive. Because of their close botanical relationship, the smokebushes were originally placed in the genus *Rhus,* but they are distinguished from that genus by their simple (that is, undivided) leaves. *Cotinus* is comprised of two, three, or four species depending on whether certain Chinese populations are considered as variants of an all-inclusive *Cotinus coggygria;* there are sound points that favor both approaches. The wood of *Cotinus* has been an important source of orange-yellow dye wherever the plant is found and continues to be so used in China.

Cotinus obovatus Rafinesque

The American smoketree (sometimes known as chittamwood) is arboreal, reaching twenty to thirty-five feet in height. It is generally larger and coarser in character than *Cotinus coggygria,* and its flowers are more modest. Its leaves are obovate in outline and can be ten to



The shaded areas on a partial, county map of the United States indicate the very limited range of our native smoketree (Cotinus obovatus). *(From Elbert L. Little, Jr., Atlas of United States Trees, Vol. 4, 1977.)*

twelve inches in length. While the leaves emerge from the buds a rich burgundy, they soon change to green. Their fall colors, which cover a spectrum that includes brilliant oranges, scarlets, purples, and russets, are among the most spectacular of all woody plants. As the mostly multitrunked trees mature, the bark develops an interesting fishscale texture.

Cotinus obovatus occurs naturally on rocky, calcareous soils in a few hilly and mountainous areas in south central United States. While not abundant, it is no longer under the pressure it experienced during the Civil War when it was harvested nearly to extinction for its dyewood. An excellent, tough, small tree, it thrives in a far greater range of conditions under cultivation than those in which it naturally occurs. For instance, it is completely cold hardy through Zone 6 and into areas of Zone 5 and will grow with no pest or disease problems in soils that are poorly drained just as well as in those similar to its native terrain. (For an extensive discussion of the horticultural attributes of *C. obovatus*, see Koller and Shadow, 1984.) It is currently available or soon to be available in the United States and could be far more widely used in our landscapes, especially in light of the current demand for regional natives.

Cotinus coggygria Scopoli

Cotinus coggygria is a large shrub that generally reaches heights of six to fifteen feet with a variable habit and a potentially equal or greater spread. The irregular, multitrunked habit contributes to its interesting architecture. The common name for *C. coggygria*, smokebush, refers to the unique inflorescences of the entire genus, which are covered with tiny, persistent hairs that give the inflorescences the appearance of plumes of smoke.

The panicles are borne at the ends of the branches, and they can be anywhere from three inches to a foot in length. Usually they are about half as wide as long, with a rounded, feathery tip. Small, dark seeds develop among the panicles over several weeks and in exceptionally prolific years can detract slightly from the ornamental quality of the inflorescences. The inflorescences range in color from a smoky ivory to rosy pink, grayish purple, and deep burgundy. At least in this country, most seedlings will bear dusty pink inflorescences that mature to smoky ivory and actually dry to shades of tan rather than the gray described in some of the older literature. (A few cultivars retain deep wine-hued panicles until they break apart.) The lovely inflorescences of *C. coggygria* are light and airy—the slightest breeze will set them dancing and waving—but they hold their structure and maintain an effective display for weeks.

Leaf shape and color are also exceptionally variable. The leaves can be three-fourths to four inches long with a circular, obovate, or elliptic outline. Color ranges from light gray-green to dark blue-green to burgundy and shades of purple. New spring growth is often red-purple or burgundy fading to green in maturity. The autumn palette includes clear yellows, oranges, scarlets, muddy wines, burgundies, purples, and brown.

An exceptional smokebush (Cotinus coggygria) *framed by surrounding trees on Meadow Road (Kim Tripp).*

Cotinus coggygria is the most widespread of the species, in nature as well as in cultivation, with a broad Eurasian native range. It occurs from south central Europe into the Mediterranean region and, with discontinuities, across the continent through the Himalayas and into China—a range it and its antecedents have occupied through fifteen million years of change. Throughout this range there is great variability of habit, foliage shape, size, and color (in new growth as well as fall display), color of inflorescence, and degree of floriferousness.

Cotinus coggygria is a tough plant that thrives in diverse landscape conditions. It will perform well in soils that range from well-drained and sandy to heavy clays, and from Zones 4 to 9. It is very drought tolerant and has no significant pest or disease problems, although some leaf spot occurs occasionally. In Zone 4 it usually dies back to the ground each winter. The root collar is hardy, however, and the new flush of growth each year is especially vigorous and, in purple-leaved plants, deeply colored.

Still, it is *Cotinus coggygria's* widely diverse leaf characteristics that have been so frequently described and widely debated. This variability of foliar and habit characteristics among any seedling population argues for inclusion of all Eurasian populations of *Cotinus* in one species—*C. coggygria*—but see *C. szechuanensis* and *C. nana*, which are discussed below. This variability no doubt explains why *C. coggygria* has been the source (in two cases as a hybrid parent) of most existing horticultural cultivars. Considering the potential for selection among such an apparently diverse gene pool, there are surprisingly few cultivars.

Habit and size of almost all of the nonhybrid cultivars is very similar but can vary among individuals depending on site and culture.

Plants in full sun are vigorous, dense, floriferous, and deeply colored. In shade they are more open and scraggly, slower growing, with sporadic flowering and reduced color. In general, the plants are multistemmed and will reach from ten to eighteen feet in height with an equal or greater spread. Plants are often broader than tall with an informal rounded to arching habit when young. With age they can develop a very irregular architecture that ranges from fascinating and picturesque to gangly and unattractive. Color retention in the cultivars with purple foliage varies with region. Plants in the north generally hold their color longer than do those in the warmer south. However, color retention can differ drastically among plants of the same cultivar depending on whether they have been grown unpruned rather than as coppiced or natural die-back shrubs, the new growth of coppiced and die-back plants being more intensely colored than that of unpruned plants.

Descriptions of selected cultivars follow. This list includes only those that the author has had personal experience of or has been able to obtain reliable information and documentation on. Unless otherwise noted, habit is as described above for the species.

'Daydream' was selected at Newport Nursery in Michigan for its dense, sterile, red-pink inflorescences and its especially deep blue-green foliage. It is sometimes advertised as a more compact form than other selections of *Cotinus coggygria.* However, although it is slower growing, it will eventually reach similar proportions. (For example, at the Arnold Arboretum a twenty-year-old plant of 'Daydream' is more than fifteen feet tall.) The inflorescences themselves are significantly tighter and more compact than other *C. coggygria* inflorescences. The smoke display tends to peak somewhat later, and panicle structure remains intact longer than that of other selections.

'Flame' *(C. coggygria* x *C. obovatus)* is a selection from Hillier's Nursery in England. Originally sold as *C. obovatus,* it is now recognized as a hybrid. It is larger than *C. coggygria,*

The fishscale pattern of the bark of the American smoketree (Rácz & Debreczy).

reaching the more tree-like proportions of *C. obovatus,* and its foliage is intermediate in size and character between those of the parents. Inflorescences are showy and pink, but it was for its dramatic scarlet-to-orange fall foliage that 'Flame' was selected.

'Foliis Purpureis' ('Rubrifolius') was named for its purple foliage, which emerges plum to wine colored and retains varying degrees of this color depending on climate. In cool climates it holds color well but it fades to a medium green in hotter ones. Inflorescences are red-pink to light pink. Other cultivars with purple leaves (like 'Velvet Cloak' or 'Royal Purple') are far more dramatic and useful in the landscape (some of which have been developed from this cultivar).

'Grace' *(Cotinus coggygria* x *C. obovatus)* is one of five hybrid seedlings raised in 1978 by

Peter Dummer of Hillier's Nursery from a cross of 'Velvet Cloak' pollinated by *C. obovatus*. Only Clone #2, 'Grace', has been named to date, and it received an award from the Royal Horticultural Society in 1983. 'Grace' is extraordinarily vigorous, quickly becoming a small tree of about twenty feet with large leaves up to six inches long. The leaves emerge burgundy colored, fade to a green still tinged with burgundy, and develop brilliant orange and red fall color. The rosy pink inflorescences are exceptionally large and showy. Its habit is more narrow and upright as a young plant than that of nonhybrid cultivars. It is an excellent choice for large gardens and landscapes, but it is too vigorous for small spaces.

'Nordine Red' ('Nordine') is promoted as the most cold hardy of the purple-leaved forms (which are less cold hardy than green-leaved forms). Named in honor of the prominent propagator Ray Nordine by Interstate Nurseries in Hamburg, Iowa, it actually originated at the Morton Arboretum in Illinois. The plant was grown there from seed received as *Cotinus coggygria* f. *purpureus* from the New York Botanical Garden. Its leaves and inflorescences are a clear red-purple, with the leaves turning scarlet-purple in the fall. Summer color retention is reported to be highly variable. It is a die-back shrub in colder areas of the country where other purple forms of *C. coggygria* are also die-back shrubs; consequently it is not yet known whether this cultivar is significantly more cold hardy than other purple-leaved forms. Nonetheless, its red-purple color makes it a striking cultivar.

'Notcutt's Variety' is nearly identical to 'Royal Purple', from which it was developed, but its foliage is slightly redder and less black-purple than that of its parent. Unlike its parent, leaf color is not retained well in the eastern United States.

'Pendulus' is an old form reported by Krüssman as having weeping branches, and one that may no longer be in cultivation.

'Pink Champagne' is an essentially green-leaved form, although early in spring the new foliage may show tinges of purple or red. This cultivar is especially floriferous with lovely clouds of light, clear pink inflorescences. It has performed especially well in the southeastern United States and retains its smoke display for a longer period than other green-foliaged, pink-smoked forms, even though most inflorescences are developed simultaneously in most years.

'Purple Supreme' bears deep purple leaves that hold their color well through the summer. Its inflorescences are a light, smoky pink.

'Purpureus' ('Atropurpureus') was named for its pale, purple-tinged inflorescences (as opposed to the foliage, which is always gray-green). This is one of the oldest cultivated forms and is frequently indistinguishable from most plants of *Cotinus coggygria* that tend to have purple-tinged inflorescences. Some have distinctly pink-purple inflorescences and a handsome upright habit, but these characteristics vary greatly. Other named selections will be more predictable in color, but this is an old, reliable form, common in established landscape plantings. For irregular massed plantings in large settings it is a good choice, but newer selections are more dramatically and uniformly ornamental.

'Red Beauty' is a striking, purple-red-leaved form from Boskoop in the Netherlands that is apparently unavailable in the United States at this time.

'Royal Purple' bears deep black-purple leaves and dark, burgundy-colored inflorescences that age to a dusty wine pink. The leaves hold their color well, even in hot climates, and brighten to a red-purple in the fall. Of the purple-leaved forms, this is the darkest hued, probably the least cold hardy, and certainly the most widely available. ('Velvet Cloak' runs a close second.) It is occasionally advertised as a compact form, which it is not, but its growth rate is somewhat slower than vigorous seedlings and hybrids. Its smoke display often begins later than in green-leaved forms, and while it is generally prolific and handsome, it is not always uniform in develop-

ment. In my experience, 'Royal Purple' has been the best purple-leaved form for use as an unpruned plant. It is spectacular in combination with silver-leaved perennials, blue-green ornamental grasses, or silver and blue-gray conifers.

'Velvet Cloak', with its intense red-violet foliage and light red-purple inflorescences, is one of the most dramatically colored cultivars. Its foliage is generally a brighter red-purple than that of 'Royal Purple'. The duration of its smoke display is especially protracted but not as dense as in other selections. The performance of this cultivar depends on whether it is grown as an unpruned or coppiced shrub. 'Velvet Cloak' is reported to hold its color well throughout the season, but these observations relate to plants grown as coppiced or die-back shrubs. When grown unpruned, the leaves lose more color over the summer than those of 'Royal Purple'. However, as a coppiced or die-back shrub, 'Velvet Cloak' gives the brightest red-purple foliage display and is the best choice for new foliage color. In warmer areas of the United States, where there is a long fall season, the foliage turns a brilliant, translucent carmine-purple in the fall, but in the most northerly areas of the country, it may simply brown and drop.

Cotinus nana W. W. Smith

Found in the dry areas of mountainous regions of Yunnan but not yet in cultivation in the United States, this species has been described as a low, compact shrub that reaches only three to four feet in height. Its leathery leaves are one-half inch long, and its flowers are crimson. Separating species by plant habit and leaf size is a debatable practice, especially within such an inherently variable genus as *Cotinus*, but the dramatic differences reported between this species and *C. coggygria* argue for further investigation. Whether the exceptionally compact habit and small leaf size are functions of environment or would be retained in cultivation is unknown. Limits of cold hardiness, drought tolerance, and other cultural information are also as yet unknown, but a truly compact *Cotinus* with red-to-pink inflorescences would be invaluable in urban landscapes, espe-

These photographs clearly illustrate the wide range of density of the inflorescences of Cotinus coggygria *(Rácz & Debreczy).*

What's Behind the "Smoke" in "Smokebush"?

The common names for *Cotinus*, "smokebush" and "smoketree," refer to its unique display as it flowers and fruits—a display that looks like a cloud of smoke throughout the summer. The ornamental smoke consists of numbers of upright, many-branched inflorescences (panicles of six to eighteen inches) that develop at the ends of the shrub's branches. Inconspicuous cream or yellowish flowers, about one-eighth of an inch across, generally appear sometime in late May or June. Fertile flowers then develop into small black seeds that resemble flattened peppercorns. Infertile flowers disintegrate, but the structure of the highly branched, paniculate inflorescence persists. Its branches bear tiny, pinkish hairs (at the bases of the pedicels) that continue to elongate and persist for weeks after flowering is finished, even if no seed is present. It is these hairs that create the smoke of the smokebush.

The color, density, rate of development, and longevity of the hairs varies widely among individual plants. *Cotinus obovatus* is dioecious (that is, with male and female flowers on different plants), and while the smoke display of this species is not as showy as that of *C. coggygria*, male plants of *C. obovatus* give better smoke displays than female plants. On the other hand, *C. coggygria* is primarily monoecious (male and female reproductive structures are borne on the same plant) with some reports of polygamous plants (unisexual flowers plus some bisexual or "perfect" flowers on the same plant). Therefore, unlike *C. obovatus*, the quality of *C. coggygria's* display is not affected by whether the plant is male or female but instead depends on density and longevity of the hairs on an individual plant. Cultivars of *C. coggygria* have been selected for prolific, deeply colored smoke displays as well as for purple foliage, good fall color, and cold hardiness.

cially if its fall color were handsome. Collectors heading to the mountains of Yunnan might wish to keep a weather-eye for this *Cotinus*, which W. W. Smith described as a very beautiful little shrub.

Cotinus szechuanensis A. Pénzes

Cotinus szechuanensis, another Chinese *Cotinus* that has been recognized as separate from *C. coggygria*, differs from the latter species in foliar characteristics. Its leaves are relatively small, almost round in outline, and with conspicuous tufts of white pubescence in the vein axils on the lower surface of the leaves. Additionally, the leaves may have a wavy margin. New foliage can be a bright red-purple. Separation of this species is debatable. However, during the history of *Cotinus*, populations of *C. szechuanensis'* antecedents were probably geographically isolated from *C. coggygria's* antecedents, perhaps during the period in which the Himalayan Mountains were formed. This isolation of antecedents may argue for continued recognition of *C. szechuanensis*. It is not in cultivation in the United States, and cultural information is unknown. However, in its native habitat in Szechuan, it is a plant of dry, open areas, and its cultivation requirements are likely to be similar to those of *C. coggygria*. Roy Lancaster recently collected seeds of *C. szechuanensis* in China, and they have been successfully germinated at Hilliers Nursery in England.

Propagation

Cotinus can be propagated from seed as well as vegetatively from rooted cuttings. (Grafting also works but is generally not necessary.) Seeds require two periods of stratification. The best seed germination is obtained with about

A century-old American smoketree (Cotinus obovatus) *on Meadow Road (Rácz & Debreczy).*

one hour of acid scarification followed by three months' cold stratification. Some growers sow seeds outdoors in the fall. In the case of *C. obovatus*, which is dioecious (that is, male and female flowers are borne on separate plants), both male and female plants are required for fertile seed production. (Very rarely, an individual plant will bear both male and female flowers that may produce a few fertile seeds.) Cuttings should be harvested as early in the growing season as possible (while growth is still very soft), then treated with high (1%) concentrations of KIBA (potassium salt of indolebutyric acid) and rooted under a relatively frequent mist regime. Mist frequency should be reduced as soon as the cuttings show signs of rooting; otherwise cuttings will quickly deteriorate. Cuttings should be overwintered undisturbed until they begin growth the following spring.

Selections for the Future

The potential for breeding and selection of superior hybrids and seedlings from the wide-ranging wild populations of *Cotinus* remains underexploited. For example, among wild-collected seedlings at the Arnold there is tremendous variability in time of initiation, density, and duration of smoke display. Some plants develop inflorescences over a protracted period, leading to a less dense but longer-lived display than other plants whose inflorescences develop nearly simultaneously (which leads to a very showy, dramatic display that usually lasts for a shorter period of time). The disintegration of inflorescence panicles also affects the display. Some plants lose panicle structure quickly and neatly while others break apart over an extended period, which leaves the plant looking ragged during this period.

There is also a range in plant habit, including what appear to be groundcover types. 'Hillside Creeper' is a selection named for evaluation by Gary Koller that is currently under observation at the Arnold Arboretum as a spreading groundcover form reaching one to two feet in height with gray-green foliage. The plant develops leaders that with age may or may not reach the full height typical of the species. It remains to be determined if the groundcover habit is truly stable or whether it might be the result of microclimate or a natural process related to layering. A low-growing selection of *Cotinus coggygria* would be very useful and attractive in dry sites. Groundcover forms of *C. obovatus* in the wild have also been informally reported by Don Shadow of Shadow Nursery in Winchester, Tennessee, but to date none have been collected for evaluation.

Cotinus performs admirably as a coppiced plant in a host of landscape settings. Selections could be chosen specifically to optimize new foliage color and vigor when cut back to the ground or grown as die-back shrubs. Flowering, however, is generally reduced or even nonexistent when the plant is grown this way, and to my eye the dramatic beauty of the full display of smoky inflorescences atop an irregularly branched crown is never equalled by die-back or coppiced shrubs grown for the foliage alone. However, periodic coppicing is an effective way to rejuvenate older plants, and when it is performed on an infrequent basis, it does not permanently sacrifice the smoke display.

Cotinus seedlings and hybrids selected for optimal combinations of uniformly dense, handsomely colored, long-lived smoke displays with bold red spring foliage and brilliant fall color would make handsome plants in the landscape. Whether under power lines, in the mixed border, in urban gardens, massed in parks, sited between hardscape elements, in droughty chalk, in wet clay, in the heat of the South, or in cold northern sites, *Cotinus* makes a reliably handsome ornamental from spring through fall.

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"A Very Valuable Shrub": *Xanthorhiza simplicissima*

Jill Nooney

Little has been written about it and it does not appear in most nursery catalogs, but yellowroot, as it's commonly known, possesses a long list of winning attributes.

It was one of the botanizing Bartrams of eighteenth-century Philadelphia, the plant-explorer William, who first described *Xanthorhiza simplicissima.* He wrote in his journal of late June or early July, 1773, from Buffalo Lick, Georgia, "This evening I discoverd a very curious Little Shrub, growing on the bottoms of these Hills & on the steep banks of the Creek. The Foliage & form of groath a little resembled the Aralia, but what was the most remarkeble in it, the root affording strong Yellow Tincture, near as fine as that of Gum boge, It has long slender branching Roots which run & spread about just under the surface of the earth, filling a large patch of ground with a numerous offspring[.] The shrub rises about 2 feet high sending up slender bending knotty stalk covered with a white smoothe bark which on being rubed off discovers a perfectly lucid Yellow wood, which dies as well as the Root, it is my Opinion a very valuable Shrub, on this account, where a fine Yellow dye is wanted."[1]

It was in fact as a dyewood that the plant was initially valued, but while it was found to give a handsome yellow to silk, on cotton and linen that yellow turned to olive when exposed to the sun. For a time it was also valued for its medicinal qualities. The roots of *Xanthorhiza* contain the yellow crystalline alkaloid known as berberine, and for much of the nineteenth century the plant was included in the American *Materia Medica* as being "preferable to all our native bitters."[2] *Xanthorhiza's* qualities as dyewood and medicine have been largely discounted, but as a landscape plant it is more valuable than ever.

Xanthorhiza simplicissima (a monotype of the Ranunculaceae, or buttercup family) is a deciduous shrub that attains from one to three feet in height. Its yellow roots (the source of the generic as well as the common name) are fibrous and suckering. The stout, yellowish-brown, brittle stems do not branch, thus the specific name *simplicissima.* The alternate pinnate leaves usually bear five sharply lobed and toothed leaflets that sometimes divide again pinnately. The leaf scar is narrow and nearly encircles the twig, giving it the segmented appearance William Bartram described in his diary. The leaves themselves, which cluster at the shoot tip, emerge as a bronze-purple color, changing to a bright green as they grow. They attain a length of four to ten inches at maturity. Autumn color is initially a clear yellow, then changes to red or purple and, as winter approaches, to tan. The foliage holds as late as December in the Boston area.

This planting of Xanthorhiza simplicissima *along Meadow Road at the base of the legume collection is more than a century old. Charles S. Sargent, founding director of the Arnold Arboretum, used American shrubs as borders along many of the roadways (Karen Madsen).*

The flowers, which are plum-colored shading into chocolate brown, emerge erect, then droop in panicles of two to six inches long that crowd together at the ends of the stem. As individuals they are interesting rather than showy; in mass, they create a purplish haze in March and April, before and just after the leaves emerge.

A native of damp woodlands from New York to Florida and as far west as Texas, *Xanthorhiza* is extremely adaptable in cultivation. It tolerates climates from Zone 3 to 9 and has survived laboratory tests to minus 55 degrees Fahrenheit. As might be expected given its natural habitat, it prefers shaded moist areas but will grow in full sun and in loose sandy soil, both of which are said to curb its vigorousness. Firsthand experience indicates that it will thrive even after being submerged in water for two to three weeks in spring. Nor did it show signs of distress in full sun with no irrigation during a droughty summer. A soil with high pH has been reported to cause some chlorosis.[3]

Xanthorhiza has no serious insect or fungal problems. Its suckering roots choke out most weeds. Indeed, the plant can become a weed itself if it is not carefully sited. Despite reports that its suckering is limited to three to six feet, experience in New England indicates that the roots will slowly spread until they are held by concrete, steel edging, or other impenetrable

barrier. Typical of its adaptability, *Xanthorhiza* tolerates soil compaction as well as drought.

Spring or fall is the best time to plant *Xanthorhiza*. Stagger the roots in rows eighteen to twenty-four inches apart and mulch well to keep weeds down. Once established, the plants need little care. A relatively minor hazard occurs with ice and piled-up snow, which can break the brittle stems. If the plants

The flowers of Xanthorhiza simplicissima *emerge erect at the end of the shoot and open before or with the unfolding of the leaves (Rácz & Debreczy).*

Year-old plantings of Xanthorhiza simplicissima *form part of the new landscape in front of the Arboretum's renovated Hunnewell Building (Karen Madsen).*

become raggedy or overgrown, cut them down in spring and they will quickly renew themselves with fresh growth. The plant is easily propagated by division and from fresh seed sown in autumn.

With its fibrous, suckering roots and tolerance of flooding, *Xanthorhiza* is a good waterside plant to hold banks in place and prevent erosion. The root structure as well as the plant's fairly fast growth rate also qualify it for wetland reclamation. The plant is attractive to wildlife as well as humans; upland game birds, songbirds, and small animals feed on the fruit. Because it grows in fairly deep shade, the plant can provide understory habitat and food where few other plants can survive.

Once established *Xanthorhiza* lives a long life. Plantings at the Arnold Arboretum have maintained their clean, neat foliage and remarkably uniform height for more than a century. E. H. Wilson considered it the finest deciduous-leaved groundcover at the Arboretum, where it was "very freely employed in border planting."[4] As a tall, large-scale groundcover it possesses enough character to be featured alone whether in full sun or partial shade and, in fact, it makes an excellent transition from sun to shade as well as from dry to wet soils. In full sun, its habit is regular and very dense, whereas in shade it is more open and loose. It forms an excellent base for interplantings of taller trees and shrubs and

can be especially effective under older plantings that have grown leggy. Its woodland look suits it to naturalistic plantings, but it is also attractive in more highly cultivated settings, where it is wise to contain its vigor within restricted areas. Its shallow, fibrous root system and extreme cold hardiness also qualify it for roof gardens.

In 1929 Nathaniel Lord Britton, former director of the New York Botanical Garden, wrote, "This low shrub has long been of great interest to botanists, pharmacists, and horticulturists."[5] If so, in recent years the interest has been invisible and inaudible. Handsome, tough, infinitely adaptable, it's surprising that *Xanthorhiza simplicissima* has *not* captured the imagination of a great many horticulturists. As a landscape plant, its combination of virtues is hard to match.

Endnotes

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A Rare Chinese Tree Flowers in North America

Frederick G. Meyer

Emmenopterys henryii *photographed in flower in Silver Spring, Maryland, by the author.*

Ernest H. Wilson, in *Plantae Wilsonianae* (1917), describes *Emmenopterys henryi* Oliver of the Rubiaceae as "one of the most strikingly beautiful trees of the Chinese forests." Although Wilson brought seeds to the Arnold Arboretum about 1907, no living plants are known from this early introduction.

The purpose of this notice is to report what is believed to be the first flowering of *Emmenopterys henryi* in the New World, an event that occurred late in July, 1994, in the collection of Dr. Allen Hirsh of Silver Spring, Maryland, a suburb of Washington, D.C. The origin of this material can be traced to an introduction by the Arnold Arboretum in 1979 (AA#579–79). The seeds, which came from the Nanjing Botanical Garden, were delivered by hand to the Arnold Arboretum by a touring delegation of botanists from the People's Republic of China. The seeds germinated after a month of cold stratification, and extra seedlings were subsequently distributed to a variety of locations, including the Woodlanders Nursery in Aiken, South Carolina. It was from this source that Dr. Hirsh purchased his plant in 1988.

The plant is now about fifteen feet tall with widespreading branches and thick, dark green leaves with reddish petioles. The showy white flowers, three-fourths of an inch long, occur in a flattish inflorescence with marginal white bracts as are found in some genera of the Rubiaceae, notably in *Pinckneya pubens* of the southeastern United States. The flowers are fragrant and the bracts turn pinkish as the seeds ripen. In China, Wilson reported trees forty to eighty feet tall. It can also be reported that the specimen in Silver Spring, Maryland, and some other specimens at the U.S. National Arboretum in Washington, D.C., survived unscathed from the frigid winter of 1994 when the temperature plummeted to –10 degrees Fahrenheit and stood at 0 degrees for several days in an unprotected site.

Outside of China, flowering of *Emmenopterys henryi* has been reported only in Italy in 1971 and in England in 1987. Herbarium specimens documenting the flowering of Dr. Hirsh's plant have been deposited in the U.S. National Arboretum herbarium (Meyer 22604). If readers know of any other plants of *Emmenopterys henryi* that have come into flower, please report the information to the Curator of the Herbarium, U.S. National Arboretum, 3501 New York Avenue, Washington, D. C. 20002.

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Karen Madsen, *Editor*

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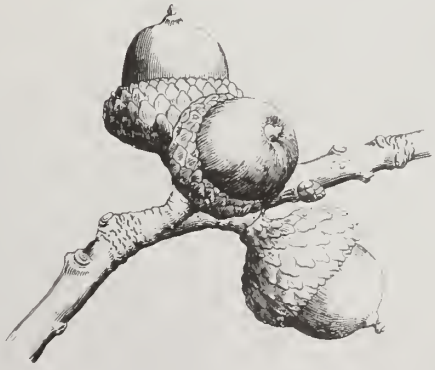
Front and back covers: The ornamental grass display at Longwood Gardens in Kennett Square, Pennsylvania, has been consistently popular with visitors. It features over seventy-five grasses that have been tried in the research nursery and found worthy of use in the mid-Atlantic region. Photograph by Rick Darke.

Inside front cover: *Quercus velutina* (black oak) pictured in Central Park, New York, in George Barrell Emerson's *Trees and Shrubs of Massachusetts*, Fourth Edition, 1875.

Inside back cover: *Miscanthus sinensis* catches the autumn light at the Case Estates of the Arnold Arboretum. Photograph by Rácz & Debreczy.



A Century of Grasses

Rick Darke

"Of late years public taste has been turned to the advantageous effect of grasses in landscape gardening. Ferns had the credit of first winning attention from colour to form, and grasses next stepped in to confirm the preference for grace and elegance over gaudy colouring. . . ." Margaret Plues, *British Grasses* (1867)

Though more than a century old, these lines capture much of the spirit behind the current fervor for ornamental grasses. Grasses are indeed enjoying a renaissance as gardeners learn to look beyond flower color to embrace the more subtle satisfactions of line, form, texture, and translucency. Lacking typical broad-petaled, brightly colored flowers, grasses derive much of their beauty from a unique set of attributes centered on line, light, and movement. Grasses provide a strong linear presence that results from the close parallel arrangement of so many narrow leaf blades. Their flowers are delicately translucent, particularly when dry, and they glow brilliantly when backlit or sidelit by the sun. Coaxed by the wind, the plumes move in and out of sun streams, creating magical flickering effects while the glossy foliage below alternates between translucency and shimmering reflection. Stirring gently in a summer breeze, dancing before an autumn storm, or flying in a spring gale, grasses mirror nature's moods and bring a special dynamism to the garden. Modern designs feature these luminous qualities and movement.

Also responsible for the renewed interest in grasses is a dramatic increase in the number of species and varieties available to today's gardener. In the Victorian heyday of ornamental grasses, a limited few such as *Arundo, Cortaderia, Miscanthus,* and *Pennisetum* were repeatedly employed, most often as specimen curiosities set into broad lawns. Plant exploration, introduction, breeding, and selection in recent decades have enriched the modern palette of ornamental grasses so that it now includes myriad variations in size, form, texture, and color to suit a multitude of purposes in the garden.

The innovative nurseryman Karl Foerster (1874–1970) was an early and constant promoter of ornamental grasses, and his influence has been wide ranging. Foerster assembled plants from around the world and grew them for evaluation in his nursery in Potsdam-Bornim, Germany. By the 1940s his catalog offered more than one hundred varieties of ornamental grasses. Foerster also developed a more naturalistic style of garden design based on his nursery trials and his observation of grasses growing in association with other plants in native habitats. His 1957 book *Einzug der Gräser und Farne in die Gärten (Using Grasses and Ferns in the Garden)* provided a record of his experiences and is still one of the most compelling works on the subject. Foerster's teachings have inspired two

Miscanthus *'Purpurascens' in the author's own garden. All photos by the author.*

Ernst Pagels (seen here with horticulturist Anke Mattern), a student of Karl Foerster, has selected and introduced many spectacular early blooming cultivars of Miscanthus *at his nursery in northwestern Germany.*

generations of German horticulturists. A superb feather-reed grass, *Calamagrostis* x *acutiflora* 'Karl Foerster', is named for him and is now common in gardens around the world.

Richard Simon of Maryland brought some of Foerster's influence and plant palette to North America in the late 1950s, when availability of ornamental grasses was at a particularly low ebb in the United States. With the help and encouragement of landscape architect Wolfgang Oehme and nurseryman Kurt Bluemel, both German-born advocates of Karl Foerster's philosophies, Simon began offering ornamental grasses through his Bluemount Nursery catalog. Bluemel's own Maryland nursery, founded in 1964, has since become the premier commercial introducer of grasses to the United States. Bluemel has worked to propagate, promote, and develop the market for new grasses introduced by institutions such as the United States National Arboretum and Longwood Gardens. One such example is the feather-reed grass *Calamagrostis brachytricha* discovered by Richard Lighty while on a Longwood-sponsored plant collecting expedition to Korea in 1966. John Creech and Sylvester March of the National Arboretum introduced a number of ornamental grasses from Japan in the mid-1970s, including the variegated *Miscanthus* cultivars 'Cabaret', 'Cosmopolitan', and 'Morning Light', as well as the diminutive green-leaved *Miscanthus* 'Yaku Jima'. These mainstays of modern horticulture were first offered commercially by Kurt Bluemel, as was *Miscanthus transmorrisonensis*, introduced from Taiwan in 1979 by Paul Meyer of the University of Pennsylvania's Morris Arboretum. In the

Foliage detail of Miscanthus sinensis *'Cabaret', introduced from Japan by the U.S. National Arboretum.*

1980s a number of stellar introductions such as *Panicum virgatum* 'Heavy Metal' and *Miscanthus sinensis* 'Sarabande' originated from Bluemel. In recent years he has been an important conduit for selections from England such as *Phalaris arundinacea* 'Feesey' and the spectacular early blooming *Miscanthus* cultivars developed by Ernst Pagels of Leer, Germany, including 'Graziella' and 'Malepartus'.

During the 1990s, many of the most important additions to the gardening world's palette of grasses have been native North American species and cultivars thereof. A fresh look at American grasslands by horticulturists from coast to coast is generating an abundance of widely adopted ornamentals. Native plant specialist Roger Raiche at the University of California's Berkeley Botanic Garden has woven many beautiful, drought-tolerant western natives such as *Festuca californica, Muhlenbergia rigens, Calamagrostis foliosa,* and *Carex spissa* into the garden's displays and has worked with nurseries to make them available. At the University of California's Santa Barbara Botanic Garden, Carol Bornstein's initiative to explore native grasses has resulted in fine introductions such as *Elymus condensatus* 'Canyon Prince'. Prairie Nursery in the Midwest has extolled the virtues of previously obscure but highly ornamental prairie species such as *Sporobolus heterolepis.* In the eastern states, Longwood Gardens' nursery trials of native American grasses have produced *Sorghastrum nutans* 'Sioux Blue'; Kurt Bluemel has developed *Panicum virgatum* 'Squaw' and 'Warrior'; and Bluemount Nursery has selected a giant, blue-leaved form of *Panicum virgatum* named 'Cloud Nine'.

Muhlenbergia rigens *(deer grass), a stunning, little-known native of the western United States, is seen naturally sidelighted against boulders in Ojai, California.*

The true grasses, which constitute the family Poaceae, are among the most highly evolved plants on the earth. It should be no wonder grasses are proving such a treasure trove of ornamentals: this truly cosmopolitan group of herbaceous annuals, perennials, and semi-woody plants includes over nine thousand species belonging to more than six hundred genera. Members of the grass family are found on all the continents in nearly all habitats. Grasses are part of almost all ecological formations and are the dominant vegetation in many, such as prairies, steppes, and savannas. Karl Foerster's characterization of grasses as "Mother Earth's hair" is not just fanciful: grasses are the principal component in more than one-fifth of the planet's vegetation cover. Immensely important economically, grasses include all the cereal crops as well as sugarcane, bamboos, canes, and reeds. Herbaceous perennial grasses are unquestionably the most varied, versatile group for purposes of landscape design.

Perennial grasses are among the easiest to grow of all garden plants. Properly utilized, they can contribute to richly rewarding landscapes that are truly low in required maintenance. Grasses are adaptable to a wide range of soil, temperature, and moisture conditions and are relatively free of pests and diseases. In native habitats the greatest number of grasses prefer sunny sites, and this is also true for the majority of ornamental species in the garden. Sun-loving species often need two-thirds to full-day sun for best performance. Shading these grasses usually results in lax, elongated

growth and diminished bloom. Light requirements may vary considerably even among related cultivars, however. Most *Miscanthus* varieties demand considerable sun, yet the cultivar 'Purpurascens' stands upright and flowers well in half shade. Some grasses need both full sun and long growing seasons. For example, many *Miscanthus* fail to develop flowers in the short seasons of the northeastern United States and northern Europe. Again, proper choice of cultivars can alleviate this problem. Ernst Pagels developed his recent *Miscanthus* introductions (including 'Graziella', 'Malepartus', 'Kleine Fontäne') with the goal of producing plants that would flower in the relatively cool, short season of northwestern Germany. These plants are extremely useful in much of England and in cooler parts of the United States. Grasses imported from warm southern climates, on the other hand, sometimes succumb during winters in northern countries. The cause may be not the low temperatures in the new environment, but instead a lack of hardiness resulting from a weak sun in the growing season. For example, *Saccharum ravennae* (better known under its synonym, *Erianthus ravennae*) flowers well and easily tolerates winter lows of zero degrees Fahrenheit in parts of the United States that enjoy hot summers. In England it often does not bloom and may fail in winter.

Although fewer than sun-loving species, there are a number of grasses native to moist, shady woodlands and woodland edges. Some of these, such as *Calamagrostis brachytricha*, *Chasmanthium latifolium*, and *Spodiopogon sibiricus* are highly ornamental choices for the shade garden. Other ornamental species such as *Deschampsia flexuosa* and *Hystrix patula* grow happily in very dry shade, which is always a difficult niche to fill in the garden.

Grasses are tolerant of many different soil types. An inquiry into the particulars of a grass's native habitat often provides insights useful for siting plants in the garden. For example, grasses such as *Miscanthus* or *Spartina* that naturally inhabit wet areas tolerate low soil aeration. These species often are ideal choices for poorly aerated garden soils such as heavy clays. Species found on infertile sands in the wild will obviously tolerate similar garden conditions; however, many also appreciate a rich garden loam. Some, such as the fescues, demand well-drained soils. These types will succumb to root rots in soils that stay moist, especially in winter. Although woodland natives respond particularly well to fertilization, it is generally unnecessary for most grasses except when they are planted in infertile sands. On rich loams and clays, fertilization can produce an overabundance of soft growth and may cause grasses to flop over.

The fibrous root systems of grasses are very efficient, making most grasses extremely drought tolerant. Once established, most ornamental grasses rarely need supplemental watering even in the driest summers. However, there is sometimes significant variation in the drought tolerance even among closely related cultivars. For example, the narrow-leaved *Miscanthus* 'Sarabande' will go through extended droughts with only minor tip burn. Broader-leaved *Miscanthus* 'Purpurascens' will scorch badly under the same conditions. Grasses roll the edges of their leaves inward in response to moisture stress, and this can be used as an indicator of the need for watering. Shade species such as *Chasmanthium* or *Spodiopogon* will perform well in full sun if given additional water in dry periods.

Grasses are generally free of pests and diseases. However, a mealybug, *Pilococcus miscanthi*, introduced to the United States in the late 1980s, now poses a serious threat to *Miscanthus*. Believed to be of Asian origin, the mealybug produces one generation per year, overwintering as adult females, with eggs hatching in spring. By fall the lower culms and insides of the leaf sheaths may be caked white with mealybugs. The mealybug attacks all parts of the plant including the roots, so aboveground mechanical or chemical methods are not sufficient for control. Drenching with systemics has proved effective; however, this is a management technique that needs to be used with the greatest caution. Preferably,

extreme care should be taken to obtain uninfected stock.

Herbaceous perennial grasses may be grouped loosely into two categories, warm season growers and cool season growers, based on the plants' physiologic cycles. Warm season grasses like it hot. They tend to sulk in cool spring weather, but once temperatures reach approximately 80 degrees Fahrenheit they begin a vigorous growth that continues unabated through summer. Most bloom toward summer's end and then die back to ground level with the onset of cold temperatures. In colder climates it is risky to divide or transplant warm season grasses in autumn; the plants' food reserves are lowest after flowering and seed set, the leaves are no longer photosynthesizing, and the roots are relatively inactive in winter. Therefore, warm season grasses are best divided or transplanted in spring after strong growth has resumed. Examples of warm season growers are *Miscanthus, Cortaderia, Pennisetum, Panicum,* and *Andropogon.*

Cool season grasses behave oppositely, growing best at temperatures below 80 degrees Fahrenheit. New foliage begins to grow in late winter or early spring, followed by spring or early summer flowers. Cool season growers sulk in summer: some simply interrupt growth, while others go into a full summer dormancy, dying to the ground. Growth resumes in autumn and often continues until winter temperatures drop below 40 degrees Fahrenheit. Cool season grasses may be divided or transplanted almost any time of year except during their hot summer lull. Examples are *Arrhenatherum,* most *Festuca* species, *Koeleria,* and *Calamagrostis* x *acutiflora.*

Although all grasses spread to some extent by rhizomes or stolons, for horticultural purposes they can be segregated into clumping and running types. Each type has its strengths for different design uses. The majority of perennial species—fescues, for example—produce only a modest annual increase in girth, effectively remaining in a clump or tuft. Since they stay in place, these types are relatively easy to control. On the other hand, they can result in high landscape maintenance if planted for groundcover since they will not fill in spaces where individual clumps have weakened or died.

Detail shows newly introduced miscanthus mealybug, Pilococcus miscanthi.

The rhizomes of running types such as *Spartina pectinata* or *Glyceria maxima* are aggressively invasive and may travel nearly three feet in a single growing season. Restraints will be required if plants are commingled with less aggressive companions. However, these are ideal for groundcover use. Only a minority of perennial grasses have the potential to be seriously invasive. Nonetheless, this aspect should be given careful consideration in choosing plants, especially if the garden is located near a sensitive native plant community. The popular *Miscanthus sinensis,* for example, is rapidly naturalizing coastal areas and bottomlands in the mid-Atlantic and southeastern United States. The new early blooming cultivars, especially those from Pagels, will certainly accelerate the naturalization of this species. The potential for invasiveness of any particular grass varies from climate to climate. *Cortaderia jubata* is a serious problem in coastal California, but it poses no threat in the cold eastern states.

Grasses that self-sow prolifically can add substantially to maintenance chores in the garden. Fortunately they are few. Especially for mass plantings near vulnerable natural communities, grasses such as *Calamagrostis* x *acutiflora* 'Karl Foerster', which rarely if ever sets viable seed, are more responsible choices.

In 1909 the nursery catalog of Storrs & Harrison Company, Ohio, commented on the place of ornamental grasses in landscape design:

> In the laying out of lawns and artistic gardens a few of the many beautiful hardy grasses should not be overlooked. Their stateliness, tropic luxuriance, and soft colors harmoniously punctuate the prevailing green, while their graceful, sinuous yielding to every wind gives animation to gardened landscapes too apt to look "fixed."

These lines acknowledge the subtle beauty of grasses and celebrate the movement they bring to the garden. However, they also stereotype grasses as curious afterthoughts useful chiefly for providing contrast with the ubiquitous lawn. Other contemporary writings and many of surprisingly more recent vintage suggest that grasses are best grouped by themselves in the garden. It is unfortunate that these two approaches have been so widely adopted since they rarely realize the potential for grasses' contribution to the landscape.

There is also a genuine concern that ornamental grasses will eventually suffer from overuse. In the American South, pampas grass has long since passed from favorite to cliché. More recently, *Miscanthus* and *Pennisetum* have become staples in the obligatory landscaping that tries to mitigate the monotony of commercial sites, but this trend may be forestalled as the wide diversity of grasses becomes better known.

The characteristic fine texture and linearity of grasses is most effective when visually balanced by other garden elements—annuals, biennials, perennials, shrubs, and trees—that contribute strong, solid forms to the composition. These might be companion plants with bold foliage such as *Silphium terebinthinaceum, Rudbeckia maxima, Petasites,* or *Gunnera.* A number of coarse biennials such as *Verbascum bombyciferum, Angelica gigas,* and *Cynara cardunculus,* as well as annuals like *Ricinus* and *Helianthus* are also ideal. Large-flowered companions such as *Hemerocallis* and *Hibiscus* provide exciting contrast, as do the dark, massive trunks of trees.

An unusually versatile group, ornamental grasses can serve infinite capacities in the garden, limited only by the imagination of the designer. Native landscapes offer a rich source of inspiration. It takes little observation to know that grasses often occur naturally in huge sweeps and masses. In savannas and prairies, they are the form and foundation, the matrix of the landscape. Space permitting, many ornamental grasses are most effective when used in these ways in the garden. Meadow gardens, by their nature, should have a consistent framework of grasses through which flowering forbs make seasonal appearances. Prairie natives such as *Andropogon* and *Schizachyrium* are obvious choices for massed plantings, especially in naturalistic gardens. Coastal lowlands in Japan are a splendid sight when millions of native *Miscanthus* bloom shoulder to shoulder in autumn. A bit of this drama can be recreated in large gardens by planting *Miscanthus* in mass. In modest gardens, a sweep of refined grass such as *Calamagrostis* x *acutiflora* 'Karl Foerster' can create a mass effect without actually occupying so much area. This same grass and taller species such as *Miscanthus* 'Giganteus' or *Saccharum ravennae* can also be massed to enclose or form garden spaces. Most grasses need not be cut back until late winter. Screens and hedges will disappear temporarily after grasses are cut back, but most reappear quickly and are fully functional through summer, autumn, and most of winter.

In wild landscapes and in the garden, grasses are especially beautiful near water. Their fine foliage is stunning when mirrored in the broad surface of a dark pool or pond. Many grasses are native to wet habitats. Ornamental vari-

Hakonechloa macra *'Aureola' in a bonsai park near Tokyo. The Japanese have long grown grasses in containers.*

ants of these species, such as *Glyceria maxima* 'Variegata' or *Spartina pectinata* 'Aureomarginata', will thrive along pond edges and streambanks. Another winning combination borrowed from native landscapes is that of feathery grasses tumbling over massive boulders. Species such as *Panicum virgatum* and *Deschampsia cespitosa* literally produce clouds of the finest textured inflorescences. These grasses are dramatic when set among rocks or stones in the garden and can make a superb backdrop for garden sculpture. Garden pathways of stone offer similar contrast. They should be wide enough to allow grasses and other plants to spill over them. Grasses are also ideal for softening overly heavy architectural features in the garden.

Although they may pale in comparison with tropical flowers, grasses are hardly without color. Modern cultivars offer summer foliage in countless shades of green as well as white (*Arrhenatherum* 'Variegatum'), yellow (*Millium effusum* 'Aureum'), blue (*Sorghastrum* 'Sioux Blue'), and red (*Imperata* 'Red Baron'). These are followed by an autumn array of golds (*Molinia* 'Skyracer'), burnt-umbers (*Sporobolus heterolepis*), and burgundies (*Panicum* 'Hänse Herms'). Indeed, grasses are unparalleled in their ability to enliven the autumn garden.

The rigors of winter fail to diminish the beauty of ornamental grasses. In the opinion of more than a few gardeners, this is their peak season. The splendid autumn tones of foliage and flowers weather gracefully to winter hues of chestnut, fawn, and russet. Frost often traces the graceful lines of grasses on winter mornings. Even in dormancy, many species

retain their shape and stature through sleet, snow, and freezing rain. Little bluestem, *Schizachyrium scoparium*, and broomsedge, *Andropogon virginicus*, paint broad golden-orange brushstrokes on winter's white canvas. Encrusted in ice, the spikelets of *Chasmanthium* become jewel-like. And the plumes of *Miscanthus* that were downy in summer become stunning filigrees in winter. Thoughtful placing of grasses so that they may be viewed from inside the house can be quite rewarding. Through a window, the movement of the grasses may catch the eye, providing a subtle connection and beckoning the gardener into the garden even in winter.

Many grasses make reasonably good groundcovers. Even though they are clumping types, the sturdy *Seslerias*, including *Sesleria caerulea*, *Sesleria autumnalis*, and *Sesleria nitida*, are low growing, long lived, and evergreen in milder climates. Prairie dropseed, *Sporobolus heterolepis*, is another clump-former suited to groundcover massing. Deep-rooted and extraordinarily drought tolerant once established, *Sporobolus* remains attractive for decades without the need for division or resetting, a claim that can be made for few perennial flowers. Spreading or running species such as *Elymus arenarius*, *Glyceria maxima* 'Variegata', and *Hakonechloa macra* often make good groundcovers. Flowering bulbs such as narcissus and tulips are happy to coexist with groundcover grasses. The bulbs usually flower earlier than the grasses and afterward their foliage is effectively masked by that of the grasses.

Japan has a long tradition of growing grasses in containers. The red-leaved *Imperata cylindrica* and variegated forms of *Hakonechloa macra* are rarely planted in Japanese landscapes, but for more than a hundred years they have been grown in decorative containers as companions to specimen bonsai. These and a host of other grasses deserve more frequent experimentation as container subjects in Western gardens. Grasses with colored foliage such as *Helictotrichon sempervirens* provide steady, multiseason interest when planted in containers with annual flowers or foliage plants. Tender perennials such as *Rhynchelytrum repens*, *Pennisetum villosum*, or *Pennisetum setaceum* and its red-leaved forms may be enjoyed in containers outdoors during the warmer months. Also, many perennial grasses are sufficiently cold hardy to remain outdoors in unprotected containers through winter. *Calamagrostis* x *acutiflora* 'Karl Foerster', for example, has easily survived zero degrees Fahrenheit in a modest-sized concrete urn at Longwood Gardens.

Allowing for their seasonal ebb and flow, grasses can be stunning specimen focal points or accents. For example, the classic symmetry of a variegated giant reed, *Arundo donax* 'Variegata', might serve as a living sculpture. Many truly have multiple seasons of interest and can carry a design through much of the year. In these instances it is especially important to take advantage of natural backlighting or sidelighting to feature the grasses' luminous qualities.

The net result of this century of design development is that ornamental grasses are no longer stereotyped as curiosities that punctuate the lawn, and the myth that they should be relegated to segregated "grass garden" groupings has been dispelled. Rather, they have become integral to the well designed year-round garden. It seems certain that the unprecedented diversity now existing in ornamental grasses will firmly and permanently establish their place in the garden palette.

This article is excerpted in part from the forthcoming *Royal Horticultural Society Manual of Grasses*. Rick Darke is also author of *For Your Garden: Ornamental Grasses*, published in 1994 by Little, Brown and Company. He is Curator of Plants at Longwood Gardens in Kennett Square, Pennsylvania, where he has been responsible for the development of the ornamental grass display.

George Barrell Emerson and the Establishment of the Arnold Arboretum

Ida Hay

"When shall we be able to point to a complete, or even a respectable, American collection of our indigenous trees and shrubs?" Perhaps more than any other individual, George Barrell Emerson was responsible for filling this need in nineteenth-century New England.

The Arnold Arboretum was officially established in March 1872, when an indenture was signed by which trustees of a bequest of James Arnold agreed to turn the fund over to Harvard College, provided the college would use it to develop an arboretum on land bequeathed earlier by Benjamin Bussey. Mastermind of this scheme was George Barrell Emerson (1797–1881), one of the trustees of the Arnold bequest. A schoolmaster and educational reformer, he widely promoted the study of natural history and pursued an interest in trees to the extent of publishing a scholarly work on them that remains valuable today.

Raised in Wells, Maine, when that state was still part of Massachusetts, Emerson spent much of his boyhood roaming the fields, woods, and seaside and working on the family's farm. After a few years of preparation at Dummer Academy in Byfield, New Hampshire, the young Emerson entered Harvard College in 1813, concentrating in mathematics and Greek.

Apparently the first thing Emerson did after getting settled at college was to visit Harvard's botanic garden, hoping to learn from Professor William Peck the names of some plants he had found in Wells that he could not identify. His father, a Harvard-educated physician, had taught him the Linnaean system of classification, and as a boy George had learned as many of the trees and plants around Wells as he could. He was pleased that Peck recognized them instantly from his descriptions.

It was an exciting time at Harvard, its Augustan age of literary achievement. Under the administration of John Thornton Kirkland, the college adopted progressive methods of education; students were being urged to think rather than recite facts by rote. Upon graduating, Emerson began a career in education himself. First as master of a private boys' school recently established in Lancaster, Massachusetts, then as the first headmaster for Boston's new English Classical School (later called English High School), he developed many of his own ideas on the best methods of education. In 1823 he opened an institution for young women in Boston.

Emerson lectured widely and published on such topics as the education of girls and women, moral education, health, home economics, and sanitation. When the Boston Society of Natural History was founded in 1830, Emerson helped to organize it. He was a very active member, holding several offices, curating one of the collections, and regularly attending meetings.

In 1832, at the beginning of Emerson's second decade as master of his school, his wife

George Barrell Emerson (1797–1881), a leader of movements to improve natural-history education at all levels, influenced his brother-in-law James Arnold (1781–1868) to leave the bequest that was used to start the Arnold Arboretum (From, respectively, R. C. Waterston, Memoir of George Barrell Emerson, LL.D., *1884, and the Archives of the Arnold Arboretum).*

and assistant in the school became ill and died. George was left with three children, aged seven, five, and three, whose healthy and proper upbringing was a source of concern to him. After two and a half years, in late November 1834, he remarried. Emerson's second wife, Mary Rotch Fleming, was a widowed sister of Sarah Arnold, wife of James. With his second marriage, George commenced a close friendship with the Rotch family, including James and Sarah Rotch Arnold. During visits to New Bedford, George and Sarah found they shared an interest in shell collecting, and James led them to neighboring geological sites.

Report on Trees and Shrubs

By 1836 Emerson had been chosen president of the Boston Society of Natural History. The following year, inspired by a recent state-funded geological survey, BSNH members proposed to undertake botanical and zoological surveys for the Massachusetts legislature. Emerson not only acted as commissioner fof the surveys but conducted the investigation of trees and shrubs himself. He worked on the project for nine summers, whenever school was not in session.

One of the goals of the surveys was to collect information on the economic importance of each subject. To find out more about how Massachusetts' trees were used and how forests or woodlots were managed, Emerson sent a circular with twenty questions to some fifty landowners in the state, and their responses provided valuable information. On his own fact-finding excursions, Emerson visited shipyards in Boston, New Bedford, and other towns, as well as numerous sawmills, machine

George B. Emerson traveled throughout Massachusetts to observe its trees, and he noted particularly large individuals of each species. In Hingham, he admired this old American elm at Rocky Nook. Emerson reported its dimensions as thirteen feet in circumference and sixty or seventy feet in height, with a crown more than ninety feet in breadth (From L. N. Dane and H. Brooks, Typical Elms and Other Trees of Massachusetts, *1890).*

shops, and workshops for making furniture, agricultural implements, and other articles using wood.

Issued in late 1846, Emerson's *Report on the Trees and Shrubs Growing Naturally in the Forests of Massachusetts* turned out to be the most popular of the volumes published in the survey. His ability to present accurate scientific information with lucidity and contagious enthusiasm was universally praised. "It is a work that every intelligent farmer, educated at a New England School, may read and understand fully—and which is at the same time as truly (not pedantically) learned, as if it had been prepared for the Academy of Sciences," reported Andrew Downing's *Horticulturist* (Anonymous, 1847, p. 566).

The main portion of the work consisted of descriptions that, drawn as they were from firsthand observation, had a freshness and vitality that took the reader out into the woods with the observant schoolmaster. The plants were arranged according to a natural system of classification based on Lindley's interpretation of the works of the Candolles. The discussions accompanying the treatment of each species incorporated such facts as the tree's usual habitat, the uses that might be made of its wood or bark, its qualities as fuel, the size it usually attained, and the locations of particularly large examples.

The introduction presented an instructive overview of Massachusetts forests. Emerson summarized the report's chief objective:

> A few generations ago, an almost unbroken forest covered the continent. The smoke from the Indian's wigwam rose only at distant intervals; and to one looking from Wachusett or Mount Washington, the small patches laid open for the cultivation of maize interrupted not perceptibly the dark green of the woods. Now, those old woods are everywhere falling. The axe has made, and is making, wanton and terrible havoc. The cunning foresight of the Yankee seems to desert him when he takes the axe in hand. The new settler clears in a year more acres than he can cultivate in ten, and destroys at a single burning many a winter's fuel, which would better be kept in reserve for his grandchildren. This profuse waste is checked, but it has not entirely ceased. It is, however, giving way to better views. Even since this survey was begun, a wiser economy shows itself. May it be universal. A brief consideration of the general use of forests on a great scale may have a tendency to produce this effect (G. B. Emerson, 1846, p. 2).

What followed was an enumeration of the benefits forests provide for man: improving and holding soil, moderating the climate, providing material for fuel and uncountable necessary objects. Emerson also discussed the nonmaterial, the aesthetic and spiritual, merits of forests and trees.

> A single tree by a farmer's house protects it, and gives it a desirable air of seclusion and rest; as if it must be a residence of peace and contentment. . . . while an unprotected, solitary house seems to shiver in the north wind, and we involuntarily wish for the inhabitants a more cheerful home (G. B. Emerson, 1846, p. 9).

Massachusetts trees, he argued, could be used not just to supply timber, but, thoughtfully planted, they could beautify many a human environment—dooryards, pastures, roadsides, estates, and public grounds.

In a section entitled "Continuation and Improvement of the Forests," Emerson argued for conservation, management, and restoration of forest resources. Such ideas were just beginning to be discussed in America. There were no governmental authorities to regulate forest use nor any forestry schools, and conservation organizations did not yet exist. Emerson summarized the experience of many landowners who answered his circular on such topics as how to plant timber trees, when to thin and prune them, how many years each species required to reach suitable size for harvest, and the methods and timing of felling. On these topics, Emerson realized that his report was merely a starting point. Much more scientific study was needed, as well as further development of the fine art of "the best disposition of trees in the landscape." Emerson was sure that Americans should start to conserve forests and plant trees. Educating them to appreciate trees

A forest of ashes (Fraxinus americana) *in Maine as pictured in Emerson's* Trees and Shrubs of Massachusetts. *He wrote, "The ash has been called the painter's tree. It is, at least while young, remarkable for its gracefulness, for the light and easy sweep of its branches, and for the softness and mellow green of its foliage. It produces a fine effect in contrast with the darker woods, and should, on that account, always have a place where it is the object to exhibit the various beauty of the forest trees" (From* Trees and Shrubs of Massachusetts, *Fourth Edition).*

was a step in the right direction; founding an institution with this role would be another step that Emerson would take.

Natural History and Landscape Gardening

Emerson's research into Massachusetts trees widened his contacts and fostered his reputation as a serious scholar. He was offered the Fisher Professorship in Natural History in 1838, but declined to take it. A few years later he supported the appointment of Asa Gray to the post. The two naturalists began a cordial relationship as soon as Gray was established at the botanic garden. Emerson sought the new professor's counsel for his report and found Gray especially helpful when composing the key to identification included in the book. The two men together measured some of the state's noteworthy trees.

When Asa Gray donated his herbarium to Harvard, Emerson was instrumental in raising the fund to endow it. After its transfer to the college, Emerson served on the visiting committee for the herbarium, and Gray turned to

him when funds were needed to advance its work. This behind-the-scenes activity is typical of Emerson's ever present support of botanical research and of his interest in education.

Emerson cherished his summers working in the countryside among the trees, and he was impressed by the estates he had seen in the course of his research. In 1847 he purchased thirty acres of land on the northeastern side of Chelsea harbor, on a promontory that stretched into Boston Bay. Although the barren site had poor, sandy soil, he was determined to clothe it with trees and anticipated his family's future pleasure in watching them grow.

Emerson was one of the first clients of the newly established landscape-gardening partnership of Robert Morris Copeland and Horace William Shaler Cleveland. Cleveland, Emerson's friend and former student, credited *Trees and Shrubs of Massachusetts* with influencing his own endeavors, and the two of them shared an experimental frame of mind with regard to tree planting. On Emerson's excessively poor and exposed land they set out many European varieties of oak, beech, birch, linden, maple, elm, ash, mountain ash, and pine to find out whether they were more hardy than the corresponding American trees. Twenty years later, in the second edition of his report, Emerson stated that the European species he planted had performed better than their native American counterparts at his seaside property. George Emerson's relationship with Cleveland undoubtedly made the schoolmaster more aware of the goals of the emerging landscape profession. Certainly he kept abreast of activities such as the founding of Mount Auburn Cemetery and became a corresponding member of the Massachusetts Horticultural Society.

Arboretum Concept Refined

Emerson's conception of a public tree collection grew from many sources. As early as 1844, in an essay on the longevity of trees, Gray condemned the lack of a good living collection of trees and shrubs in America. After a discussion of the contribution of the French botanists André Michaux and his son, François André, he stated:

> To these two persons, chiefly, are the French plantations indebted for their surpassingly rich collections of American trees and shrubs; which long since gave rise to the remark, as true at this day as it was twenty years ago, that an American must visit France to see the productions of his native forests. When shall it be said that this statement is no longer true? When shall we be able to point to a complete, or even a respectable, American collection of our indigenous trees and shrubs (Gray, in C. S. Sargent, 1889, vol. 2, p. 74)?

More than once Gray suggested to Harvard's administration that its botanic garden be supplemented by a collection of woody plants.

From discussions in the horticultural literature and reports of recently established arboreta in England, as well as from unexecuted American proposals, the concept of an arboretum as combining a beautiful space with a scientific function was beginning to emerge. Just as the naturalistic style of landscape design was introduced from Britain, so too was the formula for an all-inclusive garden of hardy trees and shrubs after which the Arnold Arboretum would be patterned. Most active in this field was John Claudius Loudon, who may have been the first person to use the word *arboretum* in modern times. His dual facility with botany and horticulture allowed him to develop the notion that an arboretum could serve both educational and aesthetic purposes.

In the creation of an arboretum for Derby, England, and in all his publications mentioning the arboretum idea, Loudon continually emphasized five elements that define this type of garden: it is a tree and shrub collection; it includes only plants hardy in the outdoor climate where the garden is located; of these, it is to be all inclusive, with at least "one of every kind" being grown; the plants must be arranged in some rational order, preferably according to a natural system of classification;

and the plants must be labeled. He further stressed that the educational tree collection should be accommodated in a pleasing landscape, often suggesting that the best way to achieve this would be to arrange the collections along one main path that forms a circuit, so that arrangement could be viewed in order by the visitor.

Unexecuted American Arboreta

Americans were apprised of English arboretum activities through reports in the horticultural literature, and the ideas were given considerable discussion in American publications. Before the creation of the Arnold Arboretum there were a few proposals for such gardens in America—most notably, Andrew Jackson Downing's 1841 plan for the Boston Public Garden and Vaux and Olmsted's 1858 *Greensward* plan for Central Park—but they went unexecuted. Included in these plans were many of the suggestions put forth by Loudon.

For Central Park Vaux and Olmsted planned to include native American trees and shrubs in an arrangement that harked back to Loudon's many proposals:

> The northeast section of the upper park is shown as an arboretum of American trees, so that everyone who wishes to do so may become acquainted with the trees and shrubs that will flourish in the open air in the northern and middle sections of our country. . . . The principal walk is intended to be so laid out, that while the trees and shrubs bordering it succeed one another in the natural order of families, each will be brought, as far as possible, into a position corresponding to its natural habits, and in which its distinguishing characteristics will be favorably exhibited (Olmsted and Kimball, 1973, pp. 230, 335).

Right down to the order of tree families, the full description of the proposed arboretum is prophetic of the Arnold Arboretum, with which Olmsted would be involved nearly twenty-five years later.

In the interim, there was another arboretum proposed for an urban park system by Emerson's lifelong friend, Horace W. S. Cleveland. In 1869 Olmsted engaged him to do some work for Prospect Park in Brooklyn. The following year Cleveland moved to Chicago, where he was placed in charge of South Park and the approach boulevards under development by Olmsted and Vaux. There Cleveland proposed that a fourteen-mile-long parkway connecting the city's three parks be treated as an arboretum on a grand scale. He thought that the usual enhancement of natural topography with plantations would not work in Chicago because the land was so flat and featureless. Instead, he suggested,

> Let the avenue form in its whole extent, an arboretum, comprising every variety of tree and shrub which will thrive in this climate, each family occupying a distinct section, of greater or lesser extent, according to its importance (Cleveland, 1869, p.17).

He proposed using masses of each kind of tree in botanical sequence along the boulevard rather than individual specimens, stressing the artistic as well as the educational effect of such an arrangement. Unfortunately Chicago's political and economic situation, the latter exacerbated by the great fire of 1871, prevented Cleveland's vision from being realized.

Emerson Masterminds the Indenture

In 1855, George Barrell Emerson turned his school over to a nephew but continued to tutor and counsel former students and stayed active in educational affairs. He began to spend more time on philanthropic activity, serving, for example, on a commission responsible for recruiting teachers for schools for freedmen in the South during the Civil War. Many affairs—the need for better natural history education, concern over man's impact on native forests, the importance of trees and naturalistic landscaping in improving public grounds, and the proposals for arboreta—were on Emerson's mind during the 1860s.

At this time James Arnold, too, was thinking of philanthropy as he revised his will after the deaths of his wife and only child in 1860. In this matter, he turned to Francis E. Parker,

The Arnold Arboretum

F A L L · N E W S · 1 9 9 4

Arboretum/National Park Service Partnership Receives Two Major Grants

Phyllis Andersen, Landscape Historian

Margie Coffin

Kristin Claeys, landscape preservation field assistant, Jack Alexander, chief plant propagator, and Gary Koller, senior horticulturist, comparing lilac cultivars from the Vanderbilt National Historic Site in Hyde Park, New York, to plants in the Arboretum's collection.

The Arboretum's partnership with the regional office of the National Park Service, known as the Olmsted Center for Landscape Preservation, is strengthened this year by the receipt of two grants for historic landscape preservation of national importance. We have just received a grant of $40,000 from the National Center for Preservation Technology and Training to produce a technical publication on the preservation of woody plants in historic landscapes. The publication will evolve out of a series of working group sessions involving professionals actively engaged in the landscape management of historic sites. It will address historic tree maintenance, the management of features such as woodlands, hedges, and vistas, the inventory and documentation of woody plants and the use of computer technology for both mapping and inventory control. We are particularly proud that this grant, one of only two awarded to landscape projects, is among the first group given by the newly created National Center for Preservation Technology and Training, which is located at Northwestern State University of Louisiana in Natchitoches. The Center, established in 1992 by an Act of Congress, is part of the National Park Service. Its mission is to develop and disseminate skills and technologies for both architectural and landscape preservation and conservation.

The Olmsted Center has also received a grant of $12,500 from the Preservation Assistance Division of the National Park Service to hold a Forum on Historic Vegetation Management at the Arnold Arboretum in the spring of 1995. This one-day event will bring together speakers from all over the country to participate in panel discussions on a variety of topics including arboricultural practices at historic sites, the management of plant succession, and the identification, condition assessment, and replacement strategies for woody plants of historic importance. The Forum will be geared to individuals responsible for the ongoing management of historic sites with some space available for the general public.

Our partnership with the Olmsted Center continues to place us in the forefront of landscape preservation work. We are unique as an arboretum in our commitment. By bringing our traditional strengths in plant identification, propagation, and woody plant management to bear on the newly emerging methods of landscape preservation we are adding solid botanical and horticultural skills

to those of landscape architects, preservation professionals, and general maintenance specialists. Our projects are diverse. Peter Del Tredici has identified plants lost to Fairsted, the home and office of Frederick Law Olmsted, from historic photographs of that site. Peter's work has contributed a new layer of authenticity to the treatment plan currently being implemented at Fairsted. Jack Alexander has grafted old apple varieties from Weir Farm, the home of American impressionist painter Alden Weir, now a property of the National Park Service, and from the Franklin Delano Roosevelt site in Hyde Park, New York, to provide replacement plants for historic orchards. The Olmsted Center, now located at the Frederick Law Olmsted National Historic Site in Brookline, has been nationally recognized as the only facility within the National Park Service devoted exclusively to historic landscape preservation, training, and technology development. The future of our partnership looks promising, and we are currently engaged in strategic planning to enable it to continue to play a leadership role in cultural and natural landscape preservation.

National Preservation Conference Honors Arboretum Staff

Bob Cook, director of the Arnold Arboretum, was given a Heritage Hero award by Roger Kennedy, director of the National Park Service, on the occasion of the 48th National Preservation Conference sponsored by the National Trust for Historic Preservation held in Boston, October 26–30, 1994. Heritage Hero awards are given to individuals who have made major contributions to the preservation mission of the National Park Service. Boston Mayor Thomas Menino was also honored with this award at a ceremony at the Park Plaza Hotel on October 27.

The renovation of Harvard Yard, including the Yard landscape, buildings, and encircling fence received the National Preservation Honor Award from the National Trust for Historic Preservation. Peter Del Tredici, assistant director for living collections, was a member of the committee that prepared the replanting plan, which will add over 250 trees to the Yard over the next 7 to 10 years. The replanting plan is a unique contribution to the field of landscape preservation in its detailed and sensitive approach to dealing with the loss of the key landscape element, the American elm.

Karen Madsen

The Arnold Arboretum interns of 1994 are, from left to right in the front row, Kirsten Thornton, Todd Forrest, Amy Spencer, Debra Castellano, Kirsten Ganshaw, and in the back row, Vincent DiFusco, Andy Bell, Amy Capron, Scott Wunderle, Lisa Farino, Chris Fannin, Merrill Whittington, Kyle Orr, and Pam Snow. Irina Kadis is missing from the photo. Their training included hands-on experience in grounds maintenance—including an extra dose of hard work on Peters Hill and Bussey Hill—labelling and mapping of trees and shrubs, plant propagation, and library curation. They also participated in plant identification and landscape maintenance classes and joined Arboretum staff members for tours and talks.

The Rain Forest Connection

Robert E. Cook, Director

Last month the Arboretum entered into an unusual collaboration with a company called Tom Snyder Productions. Supported by a $90,000 grant from the National Science Foundation, we will be working with them to develop The Rain Forest Connection, an interactive CD-ROM-based curriculum package for middle-grade students. CD-ROM is a technology that places vast volumes of information on a compact disc that can be rapidly accessed at any point. Tom Snyder Productions has extensive experience in creating award-winning educational materials that effectively integrate science content with cooperative learning, decision-making, and technology.

Based on our ongoing search for plants containing anti-cancer and anti-AIDS compounds in Indonesian tropical forests, The Rain Forest Connection will combine real-life narratives with collaborative problem-solving based on actual scientific research on the discovery and management of biological resources. The CD-ROM will include video, animation, still images, data sets, maps, remote sensing images, sound and music to provide story, information, background, incentives, and feedback. Classroom students will work in small cooperative teams made up of different scientific "experts." Each team will collect, organize, and analyze data from the CD-ROM, print booklets, and related hands-on activities. Because each student "expert" has unique information, the team can succeed only by sharing their knowledge and ideas. As the teams make decisions, the direction of the narrative changes, reflecting the consequences of their choices and presenting new opportunities for problem-solving and decision-making.

John Burley, director of our programs in Indonesia, and Andrew MacDonald, our research associate who has just returned from six months in the forests of Borneo, will be working with me and a production team at Tom Snyder to develop the narrative and ensure scientific accuracy. It promises to be a very creative collaboration and will bring the work of the Arboretum to thousands of schoolchildren across the country.

Preliminary Report of the 1994 NACPEC Germplasm-Collecting Trip to Wu Dang Mountain, Hubei Province, China: September 4 to October 11, 1994

Peter Del Tredici, Assistant Director for Living Collections

Hubei Province figures prominently in the history of the Arnold Arboretum. It has been the source of many of our most prized introductions. E. H. Wilson collected many plants in the vicinity of Yichang (on the Yangtze River) in the late 1800s and early 1900s, and in 1980 Chennongjia Mountain in the western part of the province was the principal site of the Sino-American Botanical Expedition, the first major plant-collecting expedition to China since 1949.

This fall, representatives from four of the institutions in the North American-China Plant Exploration Consortium (NACPEC), working in cooperation with the Nanjing Botanical Garden, joined in a collecting expedition to Wu Dang Mountain in northern Hubei Province. I was accompanied on the trip by Paul Meyer of the Morris Arboretum, Philadelphia, Kevin Conrad from the U.S. National Arboretum, Washington, D.C.,

Peter Del Tredici

Mr. Zen of the Science and Technology Committee, Dang Jiang Kou City in Hubei Province, holds a fruiting specimen of *Emmenopterys henryi* collected on the 1994 NACPEC Expedition.

R. William Thomas from Longwood Gardens, Kennett Square, Pennsylvania, and two botanists from the Jiangsu Institute of Botany, Mao Cailiang and Hao Riming. As well as being botanically interesting, Wu Dang Shan is famous throughout China as one of the principal centers of Daoism during the Ming Dynasty. Over 500 years ago, some 300,000 workers were employed in the building of some 46 temples and halls, 72 shrines, 39 bridges, and 12 pavilions on the mountain, many of which are still standing.

The mountain itself is 5,285 feet in elevation. A good paved road takes visitors up to about 3,000 feet, where a handful of hotels are located. Beyond this point a steep stone path leads to the summit, which is crowned with the spectacular Golden Temple. Chinese tourists and pilgrims visit the mountain at all times of year, but their impact is generally confined to the immediate vicinity of the stone path. While the vegetation adjacent to the path shows signs of wear and tear, one can find well-preserved forest just a short distance from it. Indeed, it was very exciting to see many "old friends" from the Arboretum growing in their native habitat. Among the most interesting plants whose seeds we collected were *Acer grisium, Castanea henryi, Emmenopterys henryi, Hamamelis mollis,* and *Sinowilsonia henryi.*

In all, we made 127 collections of seed that are now being processed for germination at the Dana Greenhouses. With luck, this new generation of Chinese plants will flourish at the Arboretum well into the next century. In addition, many of them will be distributed to other botanical gardens and nurseries in order to diversify the germplasm currently available in this country. Readers of *Arnoldia* can expect a more detailed report on the trip in the near future.

Karen Madsen

Support for Field Studies

Arnold Arboretum Committee president Jim Gorman recently presented a check to Diane Syverson, manager of school programs, and friends from the Joseph Lee School in Dorchester. The recent donation caps a total of $26,000 contributed by the Committee to support the participation of Boston Public School students in the Arboretum's Field Study Experiences Program.

Open House

On Sunday, October 16, Arboretum members and friends from the surrounding community joined director Bob Cook and staff for a special open house. In addition to tours of the landscape, greenhouses, and Hunnewell Building, participants enjoyed a demonstration of the Arboretum's High Ranger truck (above) with arborist John Olmsted and grounds superintendent Patrick Willoughby.

Amy L. C. Wilson

Growing Classroom Gardens

As every good gardener knows, the experience of cultivating plants engages our best observational skills and provides a fascinating close-up window on the natural world. Through a recent grant from Northeastern University's CESAME (Center for the Enhancement of Science and Mathematics Education), the Arboretum will make this experience part of the science programs at elementary schools in Dorchester, Hyde Park, and Mattapan. Coordinated by Arboretum school program manager Diane Syverson, the project will enable teachers from the Arboretum's LEAP (LEarning About Plants) program to lead children in gardening science investigations developed by the Arboretum and the National Gardening Association. Known as The Growth Connection, the program is part of the Arboretum's ongoing efforts to tap the potential of the world of plants and horticulture for hands-on science learning.

Arboretum Renovation Receives Preservation Award

Each year the Boston Preservation Alliance recognizes exemplary contributions to the preservation of the City's rich architectural and landscape heritage. This October the Arnold Arboretum received a 1994 Preservation Award for "its outstanding restoration and the creation of handicapped access in the historical Hunnewell Building, circa 1892." Preserving the historic character of both the Hunnewell Building and the surrounding landscape was a primary goal of the recent renovation, and we wish to extend recognition for the project's success to Arboretum renovation manager Sheila Connor (and horticultural research archivist), landscape architect Carol Johnson, and architectural consultants The Primary Group.

Volunteer Recognition

Amy L. C. Wilson

Loretta Wilson and Flora Bussewitz were among the many honored at the recent luncheon held in recognition of Arboretum volunteers. Al Bussewitz's illustrated lecture on Henry David Thoreau was the highlight of the event.

New Staff at the Arboretum

Karen Madsen

Todd Forrest, our new curatorial assistant in the Mapping and Labelling department, came to the Arboretum from Portland, Oregon, as a grounds-crew intern in April of this year. His primary responsibility will be updating the Arboretum's plant records using accessioning and planting lists and nursery inventory. In Oregon, Todd worked for a retail nursery as a landscape design consultant and spent his free time studying the ecology of the Douglas fir forests of the Western Cascades. He is a 1991 graduate of Wesleyan University and an inveterate plantsperson.

Ann-Marie Luciano is a recent addition to the Arnold Arboretum staff at the Harvard University Herbaria. She will be assisting John Burley with day-to-day tasks on the Biodiversity Collections Project with the government of Indonesia. Ann-Marie comes to us from the Department of Organismic and Evolutionary Biology.

Karen Madsen

She was awarded a B.S. in journalism and public relations from Northeastern University in 1993.

Karen Madsen

12th Annual Plant Sale and Auction

A splendid selection of unusual and choice plants from the Arboretum and other botanical collections, nurseries, and private collectors ensured a highly successful 12th Annual Arnold Arboretum Plant Sale and Auction. The Arboretum expresses its many thanks to the 55 volunteers who contributed over 780 hours of excellent effort to the event.

Karen Madsen

The calm before the storm: volunteers prepare to register bidders before the 12th Annual Rare Plant Auction.

Karen Madsen

New England plant societies and horticultural organizations gathered on Society Row.

Karen Madsen

Members choose their bonuses outside the Case Estates barn.

Karen Madsen

A magnolia and other plants head for new grounds.

PROGRAMS & EVENTS

The Arnold Arboretum's Education Department offers many short courses, lectures, and programs during the winter months. These cold months give gardeners the time to plan their gardening activities for the coming season, and to learn about new plant materials and horticultural techniques.
For a complete catalogue of programs and events at the Arboretum, call (617) 524–1718, ext. 162.
Please note that course fees printed in boldface are for Arboretum members.

JANUARY

HOR 377 Woody Plant Groupings: Designing With Trees and Shrubs

Laura Eisener, Landscape Designer

This class will examine the ways in which woody plants can be combined to shape space in boundary plantings. The instructor will also discuss canopy layers, understory levels, groves, allees, and orchards. The last session will emphasize ornamental pruning as a way of enhancing the effect of the tree and shrub groupings. Slides and plan drawings will be used to illustrate striking uses of woody plants.

Fee: $64, $77

4 Thursdays, January 5, 12, 19, 26/ 6:30–8:30 pm (Dana Greenhouse)

FEBRUARY

HOR 406 Building the Design: How to Solve Problems in Landscape Construction

Bob Hanss, Landscape Architect and Design/Build Professional

This course is designed for the needs of landscape professionals, but homeowners or gardeners interested in doing their own subcontracting are also welcome. The class will see slides of current or recently completed projects that illustrate how to deal with the many problems and issues of turning a plan into reality. Topics to be covered include cost analysis and materials selection.

Fee: $54, $65

3 Wednesdays, February 1, 8, 15/ 6:30–8:30 pm (Dana Greenhouse)

HOR 210 Fundamentals of Garden Design

Douglas Reed, Landscape Architect

Gardening begins with a plan, whether you are renovating an existing garden or starting from scratch. This course will help participants to visualize good garden design, get a plan down on paper, and choose plants consistent with the design.

The instructor will use lectures and slides to convey the steps in developing a plan, using before-and-after slides of garden sites and the sketches that led to the final plan drawings. Students will participate in weekly critiques of their plans in progress. Please note that all class members create a plan for the garden visited during the first class.

Prerequisite: Some knowledge of the basics of plan drawing is needed in this course.

Fee: $95, $110

1 Sunday, February 5/ 1:00–3:00 pm (Hunnewell Building and required site visit) and 5 Tuesdays, February 7, 14, 21, 28, March 7/ 6:30–8:30

HOR 277 The Business of Design

Carol Julien, Garden Designer

Every landscape practitioner, whether landscape architect, designer, installer, or maintenance specialist, has business issues that need to be successfully resolved. Experienced garden designer Carol Julien will introduce and discuss many of these business-related questions.

Fee: $40, $46

3 Mondays, February 6, 13, 27/ 6:30–8:30 pm (Dana Greenhouse)

WAL 311 Classic and Choice Garden Roses

Stephen Scanniello, Rosarian, Brooklyn Botanic Garden

As Chairman of the Heritage Rose Foundation and a judge at the International Rose Competition held each year in Paris, Stephen Scanniello sees and evaluates the best rose introductions. This beautifully illustrated slide lecture will give rose admirers a chance to shake the winter doldrums and plan spring purchases.

Fee: $15, $18

Thursday, February 16/ 7:30–9:00 pm (Hunnewell Building)

BOT 100 Introduction to Botany

James Martin, Arborist and Horticultural Instructor

An introduction to botany for students new to the discipline and a refresher for those who feel the need to brush up on old skills. Among the topics to be explored are plant cells and tissues, cell division, plant anatomy and morphology, plant diversity,

evolution, and ecology.
Fee: $98, $112
6 Tuesdays, February 21, 28, March 7, 14, 21, 28/ 6:30–8:30 pm (Dana Greenhouse)

HOR 458 Comparing the Viburnums in Form, Fruit, and Flower

Tom Ward, Manager, Dana Greenhouses, Arnold Arboretum

The viburnums offer a wide diversity of flower form, fruiting characteristics, and landscape potential. Tom Ward's talk will compare the viburnum species and cultivars in all seasons of the year and evaluate their pest and disease resistance, growth habit, and ease of cultivation.
Fee: $15, $18
Thursday, February 23/ 6:30–8:30 pm (Dana Greenhouse)

MARCH

HOR 174 Witch Hazels: Winter Fragrance and Flowers

Chris Strand, Outreach Horticulturist, Arnold Arboretum

Hamamelis, better known as witch hazel, has the wonderful ability to flower in the depths of our New England winters. Different species will be in flower from the beginning of January through the end of March. Weather permitting, this course concludes with a walk through the Arboretum's excellent witch hazel collection.
Fee: $10, $12
Thursday, March 9/ 10:00 am–noon (Dana Greenhouse)

WAL 330 China: Cradle of Species Diversity?

David Boufford, Assistant Director for Collections, Harvard University Herbaria

In this slide-illustrated course, Dr. Boufford will discuss his work with plant species native to China and Bhutan, presenting his views on current theories of species origination in eastern Asia.
Fee: $24, $28
2 Thursdays, March 23, 30/ 7:00–8:30 pm (Harvard University Herbaria)

BOT 118 Dwarf Conifers

Richard Stomberg, Manager, Harvard University Herbaria Glasshouses

Many of our common conifers have dwarf and other unusual forms. Whether they are 6-inch buns or 12-foot mops, they all add tremendous interest to our landscapes. We will also—rain or shine—walk through the Arboretum's excellent collection of dwarf conifers.
Fee: $24, $29
Saturday, March 25/ 9:30 am–12:30 pm (Dana Greenhouse and Arnold Arboretum grounds)

The Italian Garden Photographs of Charles A. Platt

The Arnold Arboretum is pleased to announce an exhibit of the photographs of landscape designer Charles A. Platt (1861–1933). Platt's 1894 publication, *Italian Gardens,* was the first illustrated volume in English to explore Italy's rich garden heritage, and thus influenced a generation of garden designers and landscape architects. The exhibit presents many of the evocative images from this landmark book and will be on view in the Hunnewell Building from December 1 through February 15. The Arnold Arboretum extends its many thanks to the Bank of Boston for its generous loan of this exhibit. For more information, please call 524–1718.

Stone pines *(Pinus pinea)* and Italian cypress *(Cupressus sempervirens),* Villa Borghese, Rome

*Seat of Benjamin Bussey, Esq., at Jamaica Plain. Oil on canvas by William A. Cobb, 1839. This landscape includes the areas of the Arnold Arboretum that have come to be known as Bussey Hill, Hemlock Hill, and the South Street Tract. South Street is plainly visible, and it is easy to see where Saw Mill Brook—now Bussey Brook—crosses it. The Bussey mansion, apparently surrounded by Lombardy poplars (*Populus nigra *'Italica'), appears in the middle ground. Bussey had begun buying up farmsteads in 1805 and continued to do so over the next thirty years. Some of the hedgerows that delineated the separate parcels appear in the painting. On the south slope of the hill, a lilac hedge, still extant today, formed one of these bounds. This view of the Arboretum from Walk Hill, near the Forest Hills Station, remains virtually unchanged today (Archives of the Arnold Arboretum).*

who was one of Boston's finest trust lawyers, skilled in helping others turn their good ideas into permanently funded institutions. It was through Parker's influence that, although Arnold was convinced that an arboretum was a much needed resource, he left his will sufficiently indefinite to allow his trustees flexibility to act. Arnold named another family friend, John James Dixwell, as the third trustee of what became the arboretum bequest. Dixwell was a prosperous merchant and president of the Massachusetts Bank. He and Emerson had long been united in their support of the Boston Society of Natural History. On his Jamaica Plain estate, on Moss Hill, Dixwell grew as many kinds of trees as he could obtain, and it was this fondness for trees that formed a bond between him and the Arnold family as well.

James Arnold died in 1868. More than three years passed from the time Arnold's will was approved by the court until the trustees, Emerson, Dixwell, and Parker, signed an in-

denture with Harvard establishing the Arnold Arboretum. With an arboretum in mind, the trustees had spent the time weighing how best to carry out their duty. To turn the Arnold fund over to Harvard College, the oldest and most prestigious center of learning in New England, would be a sure way to provide for the continuance of the trust. Both Emerson and Parker were graduates, and all three had close social and professional connections with the college.

Some time was spent considering the best place to locate the hoped-for arboretum. Since the trustees knew of Asa Gray's opinion that a tree collection was needed to complement the herbaceous plantings of the Harvard Botanic Garden, they pondered two sites suggested by the professor of botany. While one, the grounds around the astronomical observatory, had the advantage of proximity to the botanic garden, its size was limited. Gray also urged the use of "Brighton Meadows," a flat parcel along the Boston side of the Charles River that Henry W. Longfellow was planning to purchase and present to the college. George Emerson and the poet discussed this possibility, but another tract showed much greater promise than the Charles floodplain, the undulating, partially wooded land in what was then West Roxbury, bequeathed to Harvard by Benjamin Bussey.

Bussey had left his farm and funds to the college stipulating they be used to start an institution for the study of agriculture, horticulture, and related subjects. After his death in 1842 the property was subject to the life tenancies of Bussey's heirs. At the time Arnold trustees were contemplating the disposition of the fund left in their care, Harvard established the Bussey Institution, having gained the approval of Bussey's granddaughter to utilize seven acres of the West Roxbury estate. Harvard's new president, Charles Eliot, consulted with Emerson on the education programs for the agricultural center in 1869, and after completion of the building for instruction in 1871 the Bussey Institution officially opened to students. George B. Emerson wisely surmised that using land already in possession of the college would leave the entire Arnold fund available for development of the arboretum. Apparently, the parties involved agreed such use of the land would be compatible with Bussey's wishes, clearing the way for a final pact to establish the arboretum on part of the Bussey property in West Roxbury. In the indenture, signed 29 March 1872, Emerson, Dixwell, and Parker agreed to turn the Arnold fund over to the president and fellows of Harvard College, provided the college allow some 120 acres of its Bussey estate and the income of the fund to be used for:

> the establishment and support of an Arboretum, to be called the Arnold Arboretum, which shall contain, as far as is practicable, all the trees, shrubs, and herbaceous plants, either indigenous or exotic, which can be raised in the open air at the said West Roxbury, all which shall be raised or collected as fast as is practicable, and each specimen thereof shall be distinctly labelled, and [for] the support of a professor, to be called the Arnold Professor, who shall have the care and management of the said Arboretum, subject to the same control by the said President and Fellows to which the professors in the Bussey Institution are now subject, and who shall teach the knowledge of trees in the University which is in the charge of the said President and Fellows, and shall give such other instruction therein as may be naturally, directly, and usefully connected therewith. And as the entire fund, increased by the accumulations above named, under the best management and with the greatest economy, is barely sufficient to accomplish the proposed object, it is expressly provided that it shall not be diminished by supplementing any other object, however meritorious or kindred in its nature.

With the site and an endowment secure, establishment of the Arnold Arboretum achieved many of Emerson's and his colleagues' objectives. Here would be a living collection to augment the "cabinet" of the Boston Society of Natural History. With one of every kind of tree and shrub, each labeled and

available for study, and arranged after Loudon's models, it would be Emerson's report come alive, a living inventory of the region's arboreal resources.

Emerson kept in touch with the Arboretum during the ensuing decade. He and director Charles Sargent shared an interest in the writings of Vermont conservationist George Perkins Marsh, and Emerson urged Sargent to educate the public on the potential effects of forest destruction. One of the first efforts in this direction was publication of *A Few Suggestions on Tree Planting* (1875) in which Sargent argued for planting trees and for halting the uncontrolled clearing of forests. George B. Emerson was so pleased with the pamphlet that he wrote Sargent, "If the Arboretum had never produced or would never produce anything else, I shall be richly paid for all I have done for it" (Arnold Arboretum Archives, G. B. Emerson correspondence, 9 March 1876). Emerson was also instrumental in Sargent's appointment as investigator on forest trees for the Department of the Interior's Tenth Census. In March 1881, when Sargent and Olmsted were at the height of their campaign to convince city officials to bring the Arboretum into the Boston park system, Emerson died at the Brookline home of his daughter, Lucy Lowell. In memorial tributes written upon his death, Emerson was remembered fondly for his inspirational leadership in the field of education and for his activities promoting the study of natural history, not the least of which was his influence on the founding of the Arnold Arboretum.

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Now an Arnold Arboretum Associate living in Northampton, MA, Ida Hay was on the staff of the Arnold Arboretum for over twenty years. This article is excerpted from her book, *Science in the Pleasure Ground,* which will be published in December by Northeastern University Press.

Exploring the Complexities of Plant Hardiness

J. C. Raulston and Kim E. Tripp

We often use cold-hardiness ratings as the sole indicator of plant suitability for a given region. But in actuality, a much broader range of factors determines plant performance in the landscape.

In the United States plant hardiness has usually been interpreted as cold hardiness—the ability of a given plant to survive the winter of a given region. However, even in our most northerly regions, plant survival depends on a far broader set of environmental conditions than just those found in winter. In addition to extremes of cold temperature, survival is linked to the amount and seasonal timing of precipitation, the intensity of light, the annual cycle of daylength, the texture and fertility of soil, the consistency of temperatures, and the duration and degree of high temperatures. Cold, heat, sun, clouds, drought, flood, early frosts, late ice storms, compacted soils, chainsaw-bearing contractors—all can influence a plant's hardiness.

While in any region, a plant's viability depends on its fit with this entire range of local conditions, the relative importance of each environmental factor varies geographically. In the North, tolerance to cold usually assumes the greatest importance, whereas in the South, heat hardiness is more often the limiting factor, and in most of the West, drought tolerance is the predominant influence on survival. All the same, we most often focus on cold hardiness, even in Florida and California, perhaps because at least superficially, winter damage is dramatically visible and easily understood: a cold front comes through tonight and tomorrow the plants are brown. This may explain why cold hardiness has been the focus of much horticultural research and evaluation effort, with far less attention paid to the other factors. Nonetheless, no prediction of a plant's viability can be accurate without considering the diverse combination of landscape conditions.

Dealing With Frost: Tolerance vs Avoidance

Like all forms of life, plants consist largely of water, and when temperatures drop low enough, that internal water, like all water, can freeze. Perennial plants fall into two categories based on the way they deal with frost and freezing temperatures: they can either tolerate freezing by employing a variety of physiological mechanisms; or they can avoid freezing by shedding or insulating vulnerable plant parts. Most temperate perennial plants use a combination of tolerance and avoidance to survive winter's freezing temperatures, but rely primarily on the tolerance mechanisms (which are generally more effective for surviving long periods of freezing temperatures) to protect aboveground, persistent tissues. For example, evergreen woody plants tolerate freezing in both stems and leaves while deciduous trees avoid freezing in their leaves by dropping them and tolerate freezing only in their persistent branches and trunks.

The Importance of Acclimation

A frost-hardy plant's ability to get through the winter depends on the seasonal change in its metabolism to a quiescent or dormant state

Buxus sempervirens *(boxwood) all dressed up for winter. These extreme, albeit artistic, measures protect the plants against damage from snow and ice (Peter Del Tredici).*

known as *acclimation,* which is influenced by a variety of environmental factors. Acclimation is the process whereby the plant "hardens off" for winter. In order for a normally cold-hardy plant to survive the most severely cold temperatures it is genetically capable of surviving, it must complete the acclimation process before experiencing severe cold; otherwise it will be damaged. Similarly in the spring, as temperatures warm and days lengthen, plants need to deacclimate in order to resume active growth.

There are four cases in which a plant can be damaged by freezing temperatures:

1. When temperatures fall below the plant's maximum cold-hardiness limit, even after normal acclimation has occurred;
2. When premature freezing occurs before the plant has acclimated in the fall, even if the plant is potentially able to survive those temperatures in midwinter;
3. When unusually late freezes occur in the spring after the plant has deacclimated, even if it can survive those temperatures while it is hardened off in midwinter; and
4. When there are prolonged swings in temperature during the winter that cause the plant to deacclimate before the threat of severe freezing is over.

Only the first case relates to the traditional definition of cold hardiness—the definition expressed in hardiness zone maps. In the other three cases, freezing damage occurs not be-

cause the plant is located where temperatures fall below its potential maximum cold tolerance, but because its stage of acclimation is out of step with the weather. If a woody plant that is normally winter hardy to –20 degrees Fahrenheit experienced such temperatures in July, it would suffer severe damage and is likely to die. However, this same plant could experience decades with those minimum winter temperatures and thrive.

Mapping Cold Hardiness

Hardiness zone maps generally identify areas with similar average minimum temperature ranges in which, theoretically, the same groups of plants should be viable.[1] But these systems have a serious limitation. They do not take into account all of the different environmental conditions that vary from region to region, from soils to rainfall patterns, and this limitation causes problems. Consider just one example, zone 8, which encompasses Raleigh, North Carolina; Dallas, Texas; Phoenix, Arizona; and Seattle, Washington. Then compare the plants that are grown in those areas. At least twenty-five species of palm grow in Phoenix that won't grow in Raleigh. The extremes of temperature are very different even though the averages lump Raleigh and Phoenix into the same zone.

The same problem turns up in the hardiness zone maps for Europe and China that were published in Germany in the 1970s.[2] There we find Raleigh in the same zone as London. However, Raleigh has more extreme temperatures (especially during the summer), more variable precipitation, more frequent ice storms, less cloud cover and fog, and much higher light intensity year-round. These differences influence cold hardiness, and a given plant grown in England may be less cold hardy there than the same plant grown in Raleigh. Over an entire year, variables like availability of photosynthate for growth, accumulation of storage carbohydrates, timing of flowering and fruiting, and amount of root development as influenced by moisture availability, can influence a plant's ability to survive the winter. Clearly hardiness zones based on temperature alone cannot predict a plant's ability to survive.

A better system for mapping plant adaptability is the one developed by Sunset Books, called the "Sunset Zones." This system, which includes Colorado and points west, presents twenty-four zones that are defined by many variables, including high and low temperatures, dry desert winds, rainfall, and other moisture (for instance, fog cover). This system is widely used in the West and has proven very helpful there. It's especially effective at pinpointing microclimates, a critical tool on the West Coast, where great differences occur over short distances. Los Angeles alone has nine different zones.

Another excellent system is the Walter System, developed in Germany. It is based on a graphic presentation of average monthly temperatures combined with average monthly amounts and kinds of precipitation over a full year, using data collected from Walter Stations in cities all over the world. By looking, for example, at the graph for Seattle we can see not only the amount of rainfall but also the temperatures during the months of high and low rainfall. Each station graph also shows the extremes of temperature recorded for the station and altitude of the station. In just one visual image the Walter System gives a much more complete picture of what the growing conditions are for that area than the temperature-based USDA zone map can give.

[1] See Peter Del Tredici, *Arnoldia* (Fall 1990) 50 (3):16–20.

[2] Gerd Krüssman, *Manual of Cultivated Broad-Leaved Trees and Shrubs*, Vol. 1. Timber Press: 1976.

Why Plants Die of Cold

To understand the importance of acclimation, we need to look at the process whereby plants die from the cold. There are several kinds of cold injury, but a primary cause of frost- or freeze-related death in woody plants is water freezing within the plant's cells. When water crystallizes and freezes within a cell, it ruptures and kills the cell. If enough cells are killed, the plant will suffer significant stress and the entire organism may die. On the other hand, if freezing is restricted to water in the intercellular spaces of the plant's tissue—that is, in the spaces between the cells, outside the boundary membranes of the cells themselves—then usually the cells are not damaged and the plant does not suffer.

The cells' contents change during acclimation such that the concentration of solutes increases. We know that adding certain solutes to water can retard its freezing, and that the higher the concentration of these solutes, the lower the temperature required to freeze the solution—this is how antifreeze works in a car radiator. In general, the intercellular solution in a woody plant—the liquid between the cells—has a lower concentration of solutes than the solution inside the cells. This difference is accentuated after acclimation, leading to more solutes in the cells. Therefore, the solution outside the cell walls freezes at a higher temperature—and earlier—than the solution inside the cell walls.

Because of this differential solute concentration, ice formation is restricted to the intercellular spaces during normal winters. If the temperature goes significantly below the plant's tolerance, however, the osmotically driven maintenance of the concentration differential between the inter- and intracellular solutions cannot be maintained; in that case, ice finally forms inside the cells, causing them to rupture and die.

The lesson here is that for plants to acclimate themselves to winter, temperatures must drop during the appropriate season and at the appropriate rate. A plant of ivy *(Hedera helix)* that has had a chance to acclimate can survive –30 degrees Fahrenheit, but it will freeze at 25 degrees Fahrenheit if that temperature occurs in the summer during active growth.

In any discussion of hardiness, it is important to remember that plants are made up of many different organs. The specific mechanisms of acclimation that result in freezing tolerance or avoidance vary among organs, and therefore hardiness does as well, which makes sense considering the different environments in which various plant organs occur. Roots, for example, are much less hardy than the shoots of woody temperate plants. Because of the insulating properties of soil, roots experience much less variation in temperature throughout the year than occurs in the air above it. This becomes an especially important consideration when dealing with container plants. The temperatures that containerized plant roots are exposed to are potentially much more extreme than those experienced by roots insulated in the soil—lower in winter and higher in summer.

There can also be significant differences in hardiness even among the aboveground parts of the plant. For example, flower buds are usually much less cold hardy than vegetative buds. Here in Massachusetts you are likely to see effects of the snowline in the spring where parts of the plant below the snowline have survived, be they floral or vegetative. But above the snowline, the flower buds may be killed while the vegetative buds will break and develop healthy foliage in the spring.

Environmental Cues for Seasonal Acclimation

The mechanisms described above—collectively referred to as *acclimation*—are triggered within the plant by environmental cues, of which the most important are seasonal changes in daylength and temperature. Differences among plant species range from the purely photoperiodic in which temperature plays almost no role to those that are purely temperature-controlled with no response to photoperiod (*i.e.*, daylength). Most plants fall somewhere between these two extremes. In

The flowering pattern of this azalea clearly demonstrates that winter's kill line coincided with its snow line (J. C. Raulston).

spring, once daylength extends beyond a certain point—known as *critical daylength*—deacclimation is initiated in photoperiodically sensitive species, active growth is triggered, and the plant will not become quiescent again until the shortened daylengths again trigger acclimation the following fall. Because the daylengths differ throughout the year at different distances from the equator, the cues that trigger spring growth (and winter acclimation as well) in a plant of Floridian provenance will be slightly different than those for a plant of Canadian provenance. In Canada, critical daylength will be much longer than in Florida. Not only is winter longer in Canada, but also the days become much longer earlier in the spring the farther north you go. So if you moved a Florida red maple north to Canada, it might begin active growth too early in the spring and thus be subject to freezing damage. On the other hand, if you moved a Canadian red maple south to Florida, the days may never get long enough to trigger active growth in the northern plant, and the plant would never break dormancy and grow.

Photoperiod responses can be influenced by artificial lights as well as by the sun. There are documented instances of delayed leaf fall in autumn on trees adjacent to streetlights, as well as premature initiation of growth on conifers decorated with large, nonflashing Christmas lights in midwinter. This is usually not a significant problem because cold temperatures generally override the influence of artificial lights.

In nonphotoperiodically triggered species, temperature is the most important cue for winter acclimation. Not only absolute tem-

Rhododendrons on Boston's Copley Plaza show dessication caused by sun and wind on parts of the plant not protected by snow (J. C. Raulston).

peratures, but also cumulative temperatures throughout the growing season play an important role, especially when we start moving plants around the globe. Many woody plants that are native to climates with long, hot summers can withstand very cold winter temperatures when grown in similar climates, yet if grown in climates with cooler summers and mild winters they are less cold hardy. In other words, the conditions for the previous season's growth can effect a plant's ability to withstand cold. This makes sense when we consider that growing conditions can affect processes like photosynthesis and carbohydrate metabolism. If a plant grows in a high light environment—for example, in the American Southwest—it may be able to store much greater quantities of carbohydrate, which may improve its ability to acclimate to severe cold. If you take the same plant, however, and grow it in a lower light climate, even one with a milder winter—Britain, for example—this same plant may not be able to survive that milder winter because the conditions of the previous growing season have prevented the plant from satisfying its physiological requirements for optimal winter acclimation.

As a specific example, crape myrtles *(Lagerstroemia indica)* are perfectly winter hardy in North Carolina where sunlight is intense, the summers are long and hot, night temperatures are high, and winter temperatures routinely drop to zero degrees Fahrenheit. But try to grow crape myrtles in England, where light is low and summers are cooler, and the plants will not survive winter, even though the temperature rarely falls below 10 degrees Fahrenheit. This is an example of the cumula-

tive effect of annual conditions on winter hardiness.

The Significance of Provenance

We tend to characterize an entire species as being of a certain degree of hardiness. Even within a species, however, individual plants adapt to the cues that are present in their specific region at the critical transitional times of the year—for example, daylength, light intensity, cumulative temperature, or moisture conditions. When we move a plant to another region, we may interfere with those cues and prevent the plant from exhibiting its "normal" hardiness.

Reproduction from seed is a sexual process that results in genetically variable offspring. Any population of seedlings will demonstrate an amazing array of variability. For example, a row of seedling "blue" spruces will include green, blue, and gray *Picea pungens*. Part of what genetic variation is about is survival. The populations of a species now found in a given region are therefore those that adapted over many thousands of years to the specific climate of that region. If over a few hundred years the weather gets colder in part of a species' territory, seedlings that are more cold hardy will survive and those that aren't will be frozen out. The result, then, is a population that varies widely in cold hardiness from one end of its range to the other. Red maples *(Acer rubrum)*, for example, occur in wild populations from Florida through Canada, but red maples of Floridian provenance are likely to be far less cold hardy than red maples of Canadian provenance. (It is important to note that the hardiness of a given seedling depends not on the location of the *nursery* where it was grown, but rather on the ancestral location of the *parent trees* from which the seed was collected.)

But the combination of evolutionary genetics and long-term climate changes can play tricks on us. For example, there are several species of plants now found growing only in Florida that are completely cold hardy at far more northerly latitudes. During the most recent glacial era, these plants germinated successfully south of the glacial front but did not survive in glaciated areas. As a result, these species retreated southward in front of the slowly advancing glaciers. This long-term process did not cause a loss of cold hardiness in the plant's genome, which had evolved preglacially in much colder environments than those in which the surviving plants were later found. As a result, one can grow *Magnolia ashei*, which is now native only to the panhandle of Florida, as far north as Chicago and Toronto. Red maples in Florida, however, are the product of continuous evolution in that region, rather than of migration from the north ahead of the glacier. Unlike *M. ashei*, therefore, a Floridian red maple seedling is not likely to perform well in Chicago or Toronto. Nonetheless, conventional thinking holds that *Acer rubrum* is significantly more cold hardy than *M. ashei*.

The Effects of Human Intervention on Cold Hardiness

Whether a plant can thrive in a specific environment depends on the interaction of the plant with its environment. In other words, we must consider not only what the environment is doing, but also what the plant is doing. Humans often influence both elements and thereby significantly affect the cold hardiness of a given plant.

It's easy to imagine how we can change the environment to influence a plant's cold hardiness—an extreme example would be to put it in a greenhouse—but it's harder to imagine how we can influence the plant itself to affect its hardiness. However, horticulturists can influence a plant's hardiness both intentionally and unintentionally. For example, watering and fertilizing late in the season, to keep plants looking attractive or to push a second flush of growth, can lead to disaster. Comparison at North Carolina State University of azaleas fertilized throughout the growing season with plants fertilized only in spring demonstrated that the heavily fertilized plants looked

more attractive in the fall but suffered much greater winter damage and were less attractive the following spring. In another experiment, we promoted and distributed plants of a Japanese species of crape myrtle, *Lagerstroemia fauriei*, after finding it hardy to –10 degrees Fahrenheit. However, growers complained that their plants died after experiencing minimum winter temperatures of +10 Fahrenheit. The growers had prevented the plants from hardening off for winter by prolonging irrigation and fertilization into late fall in order to increase annual growth and, thereby, profitability. The result was that the plants went into winter with soft, nonacclimated growth that was very vulnerable to freezing damage. In effect, the plant's metabolism was affected by growing practices that created an artificial

Hardiness Evaluation for the Southeastern United States

Gardeners in the Northeast enjoy the benefits of a long tradition of plant importation and hardiness evaluation, but in the Southeast there has been very little institutional evaluation of plant adaptability and performance—until recently, that is. Just seventeen years ago, the North Carolina State University Arboretum was founded with a dual mission: determining the adaptability of new and uncommon landscape plants for use in the southeastern United States, and promoting the production and utilization of superior, adapted plants. Since 1977, the Arboretum has collected and evaluated over 9,000 plants from forty-five countries—this on only eight hard-working acres. Those eight acres currently contain over 5,000 different species and cultivars in over 450 genera.

Experience has led us to believe that the only way to test a plant's adaptability is to try growing it. This method results in large numbers of killed plants, but it has also uncovered exceptional plants that perform beautifully despite very different provenances. We've learned as much from the deaths as from the successes. It's by studying what happened that we find indications of how the plant or the environment can be modified for future success. We retain for selection and promotion those plants of significant ornamental value that have survived the various environmental stresses—and they have been many. In the years since the Arboretum was established we have experienced almost every extreme of weather including the coldest temperature ever recorded, the hottest summer, both the wettest and the driest years, and the earliest and latest frosts.

We've found wonderful surprises among both exotics and North American natives. Certainly natives have been underused and deserve greater attention and selection, but the key to the suitability of a plant lies in its adaptability, not its nativity. Many natives of the southeastern United States evolved in very specialized environments. Those from the cool, moist southern mountains often don't survive in the hot, wet summer of the Piedmont while exotics from analogous climates—for instance, humid areas of Japan and Korea—have proved very useful.

Since the Arboretum's mission is to encourage the production and use of the widest possible array of plants, our distribution and advocacy program is just as important as our evaluations. We make material available to the public, to other botanical gardens, and to the nursery trade—so far over 60,000 plants of 1,000 taxa have been distributed to nurseries and other growers around the world, and in order to move these plants to the public quickly, growers themselves have collected over 2,000,000 cuttings from the plantings.

microclimate to which the plant was not adapted.

It is especially easy to create microclimate effects in order to influence plant/environment interactions in an urban environment. The magnolias on east-west streets in Boston's Back Bay are a case in point. Magnolias on the south-facing side of the streets reach full bloom when those on the shady north-facing side are just budding up. A late freeze would kill the blooms on the south-facing side, while the blooms on the north-facing side may be only minimally damaged. By planting early blooming plants in northern exposures or under higher canopies, we can minimize this kind of damage. Likewise, since a body of water can moderate local climate considerably, planting near small water features can extend your season, just as planting near south-facing brick or stone walls can, and it shares the same potential problem—spring growth may be induced so early that the microclimate is unable to protect the new growth from severe late freezes.

The winter injury to this south-facing side of a tree trunk might have been avoided by siting it in the shade or wrapping it during the winter (J. C. Raulston).

Just as north-facing or south-facing orientation can have a major impact on plant performance, whether a plant is primarily in sun or shade can make a dramatic difference in winter survival and performance. This can be a particularly important consideration in preventing winter damage on broad-leaved evergreens, especially the damage we call winter scorch. Plants lose water through their leaves constantly in the process of transpiration. Deciduous plants drop their leaves in the winter, avoiding this problem, but evergreens must contend with it year-round. Transpiration is increased by sunlight and wind. One of the ways this happens is that sunlight on the leaf increases the difference in temperature between the leaf surface and the air, thereby increasing water loss from the leaf. In winter, when water in the soil is frozen, it is impossible for the plant replace the water that is lost from the leaves, and the leaf dessicates and may die. But if it is sited in shade the plant will be more protected from the possibility of winter scorch.

Sun scorch in winter can also occur on the south-facing side of trunks of trees. This is caused by the rapid expansion and contraction of the trunk in response to rapidly changing temperatures. Wrapping the trunk so that it is effectively shaded all winter (being sure to remove the wrap during the growing season) can help to ameliorate this problem. (Make sure to wrap from the bottom up if using a wrap of narrow width so it doesn't collect water that freezes and thaws against the trunk, damaging bark and promoting disease.)

In the final analysis, the complexities of plant hardiness lie in the maze of environmental conditions that both plant and gardener

must negotiate each year. Because these conditions vary so greatly, even from one neighboring landscape to the next, and because humans can drastically alter the immediate growing environment of a plant, there is only one sure way to determine if an individual plant will thrive for you: you must try it in your own garden. To paraphrase the great English plantsman Sir Peter Smithers, I consider every plant hardy until I have killed it myself.

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A Late Summer Ornamental: *Poliothyrsis sinensis*

Stephen A. Spongberg

A handsome shrub with many desirable traits seeks a common name.

Relatively few shrubs or small trees are notable for their characteristic of flowering late in the summer season and into the fall, when the ornamental attributes of most woody plants consist of their fruits and fall foliage color. Within the past fifteen years, however, the Arnold Arboretum has received two shrubs as new introductions from China, both previously lost to cultivation, that have proved to be noteworthy, late summer-flowering ornamentals. The so-called seven-son flower *(Heptacodium miconioides)* has received some attention in the horticultural press (Koller, 1986). Introduced by the 1980 Sino-American Botanical Expedition, *Heptacodium* has become established in the nursery trade and is now available both locally in New England from Haskell's nursery in New Bedford, Massachusetts, as well as by mail order from Wayside Gardens, Hodges, South Carolina. The second plant, *Poliothyrsis sinensis,* however, has not to my knowledge been heralded in the American horticultural press although English botanists and plantsmen have chronicled its history in cultivation in the British Isles. It is so little known, moreover, that no common name has been coined for this interesting plant.

This species, the sole member of the genus *Poliothyrsis,* belongs to the otherwise largely tropical plant family Flacourtiaceae, and the only other genus in the family grown in the Arnold Arboretum is *Idesia,* also represented by a solitary species, *I. polycarpa.* First discovered by Augustine Henry at the end of the last century in central China, *P. sinensis* was not introduced into western gardens until the legendary plant collector E. H. Wilson supplied the Arnold Arboretum with seeds in 1908. Interestingly enough, these seeds were shared with botanical and horticultural institutions in Europe, where the plant has survived in cultivation to this day. At the Arnold Arboretum, however, established plants grown from Wilson's seed introduction were inexplicably removed from the collections in 1933. The reintroduction of the species to our collections in 1981, when seeds were received from the Shanghai Botanical Garden, has provided us with another opportunity to evaluate this plant under Massachusetts growing conditions.

Two plants resulting from the seedlot from Shanghai were planted in a sunny location near the site of the old Bussey mansion. They are now multiple-stemmed shrubs approaching twelve feet in height, although in nature the plants apparently develop into moderate-sized trees to fifty feet in height. In habit our shrubs are rather upright, although their ultimate shape and height, as well as the bark of the stems, will undoubtedly change should the plants persist in our collections. Both, however, have been flowering annually—commencing in 1990—during late August and September. Numerous small, yellowish-white flowers are produced in moderately large inflorescences on the current year's growth and contrast nicely with the dark, emerald-green leaves, which are borne on reddish stalks. Indeed, it was the attractive, lustrous green

leaves that first drew my attention to these shrubs. And while the reddish or almost magenta-colored petiole suggested that the fall color of the leaf blades might be of a similar hue, those of our plants assume a warm yellow in late October and November.

The flowers are either staminate or carpellate (the plants are monecious) and include four to six sepals, the whorl of petals being absent. The carpellate ones develop into interesting capsules reminiscent in size and shape of those of the lilac. These ripen to a greenish-gray color, when the outer covering falls away to reveal the tan inner walls of the capsules. Once the outer walls have been sloughed off, the inner walls dehisce by three valves from the apex, and likewise, by three from the base. While the capsules are dissimilar in shape and substance from those of *Franklinia alatamaha,* the dehiscence pattern—from both the apex and base of the capsule—is shared by these otherwise unrelated genera

The inflorescences of Poliothyrsis sinensis *are produced on the current year's growth in terminal corymbose racemes and contrast with the dark green leaves (Rász & Debreczy).*

Two Poliothyrsis sinensis *grown from seeds received in 1981 are now approaching a height of twelve feet (Karen Madsen).*

and is unknown in other woody genera cultivated in the Arnold Arboretum. These opened capsules, moreover, persist on the shrubs into the winter months, adding to the landscape interest of the plants during that time of year.

To date, our plants from Shanghai have suffered no winter damage, and the fact that the original plants introduced by Wilson persisted in the Arboretum's collections for twenty-five years suggests that *Poliothyrsis* is perfectly hardy in the Boston Basin. Its limits of hardiness and its potential as a landscape plant, however, have yet to be determined.

Poliothyrsis sinensis is currently available in the North American nursery trade from Woodlanders, Inc., 1128 Collecton Avenue, Aiken, South Carolina 29801; Glasshouseworks Greenhouses, P.O. Box 97, Stewart, Ohio 45778; and Heronswood Nursery, 7530 288th Street NE, Kingston, Washington 98346. And plans have been made to propagate the plants at the Arnold Arboretum and to make them available at a future Arboretum Plant Sale. As a consequence, this interesting Chinese species, easily propagated by seed and softwood cuttings, will undoubtedly find its way into the gardens of those who enjoy growing the curious and little known—in this instance a shrub that flowers and provides landscape interest at an unlikely time of year.

Initially lime green in color, the fruits mature to a light tan color before dehiscing to disclose the numerous, small, winged seeds produced within (Rász & Debreczy).

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Stephen A. Spongberg, Horticultural Taxonomist at the Arnold Arboretum, was a member of the 1980 and 1986 Sino-American Botanical Expeditions to China. At the Arboretum he is responsible for the curation of the living collections.

BOOK NOTES

The Planters of the English Landscape Garden: Botany, Trees and the Georgics. Douglas D. C. Chambers. New Haven: Yale University Press for the Paul Mellon Centre for Studies in British Art., 1993. 214 pages. Hardcover. $45.00

Garden history is a young field, and like all adolescents it is struggling to free itself from familial ties, in this case the disciplines of art history and literary theory. Chambers, a professor of English at the University of Toronto, moves the field of garden history beyond the social history of patrons and the documentation of careers of designers to an approach in which plants and planters—gardener, nurseryman, and amateur botanist-owner alike—take center stage. He focuses on the period from the middle of the seventeenth century to the middle of the eighteenth, when Stowe, Stourhead, Chiswick, and Rousham, the great icons of the English landscape garden, were being developed. Chambers' descriptions of the processes and materials of gardening are greatly enhanced by his familiarity with the botanical and horticultural history of the period. This was an era of extensive plant exploration and importation combined with the profound scientific contribution of Linnaeus' elaboration of the principles of taxonomy.

The opening essay, "The Patriots of Horticulture," is an excellent stand-alone commentary on English garden theory and its relationship to classical ideas of husbandry. Chambers identifies Virgil's Georgics as the aesthetic model for this new landscape. From this text he extracts classical concepts of arcadia, including the idea of rural withdrawal, the integration of farming and gardening ("the unity of beauty with profit and use with pleasure"), and the alliance of science and imagination in our understanding of nature.

Chambers also cites the influence of John Evelyn's *Silva* (1664) and *Dendrologia* (1706) on a new generation of estate builders. Evelyn's writings encouraged a massive replanting of English woodlands devastated by war. His motivation has been described as economic or technical, but the *Silva* had the unexpected effect of promoting the great wealth of trees available to the British gardener, not least the newly imported and highly valued North American species. His book inspired the planting of thousands of acres of both native and imported species, an effect that in turn required the development of new methods of transportation, planting, nursery management, and propagation.

Chambers examines the writings of Stephen Switzer, Lord Shaftesbury, and others for their ideas about appropriateness in plantings in a world of expanding options. Chambers also focuses in detail on the work of Lord Petre at Thorndon Hall, his estate in Essex. Petre's plans included massive tree-planting schemes that are described as combining beauty with botany: "The landscape and the greenhouse are one continuum."

Chambers' book is not unique in its focus on plants and planting techniques. Claudia Lazzaro, in her recent book, *The Italian Renaissance Garden: From the Convention of Planting, Design and Ornament to the Grand Gardens of Sixteenth Century Italy* (Yale University Press, 1990), places great emphasis on the contribution of plants to the architectural character of the Italian garden. She describes specific plants and their treatment as features in a larger composition. In her epilogue, she reflects on the transformation of these gardens over the years due to the maturation of plants and the changes in maintenance that have been dictated by changing tastes. This is an area all too often neglected by historians and one that needs far more work to support reponsible efforts in present-day garden restoration projects.

Landscape historians John Dixon Hunt and

Joachim Wolschke-Bulmahn have recommended that garden history reach out beyond "high culture" to "lost habits of mind" to illuminate subjects that have been relegated to the margins. Both Chambers and Lazzaro are to be commended for bypassing a traditional academic approach and revealing the rich history of the planting process, a blend of craft, science, and technology.

Phyllis Andersen

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The Greek Plant World. Hellmut Baumann. Translated and augmented by William T. Stearn and Eldwyth Ruth Stearn. Portland, OR: Timber Press, 1993. 252 pages; 481 illustrations, most in color. Hardcover. $29.95.

De Causis Plantarum. Volumes 2, 3. Theophrastus. Translated and edited by Benedict Einarson and G. K. K. Link. Greek and English texts on facing pages. Cambridge: Loeb Classical Library (nos. 474 and 475), Harvard University Press. 1990. 361 and 465 pages respectively. $15.50 each

For those interested in historic landscapes *The Greek Plant World* is a must. The author has painstakingly collected all references to plants in the writings of ancient Greeks—as well as references in works *about* the ancient Greeks—and assembled them in highly coherent and readable fashion. An excellent index makes it easy to track down what Homer, Herodotus, Plato, or Dioscorides had to say about a particular plant.

It would be a great book to read before visiting Greece, given that most of the plants covered are illustrated in sharp color photographs and are still growing there today. The armchair traveler, too, will find interest in its portraits of daily life in ancient Greece.

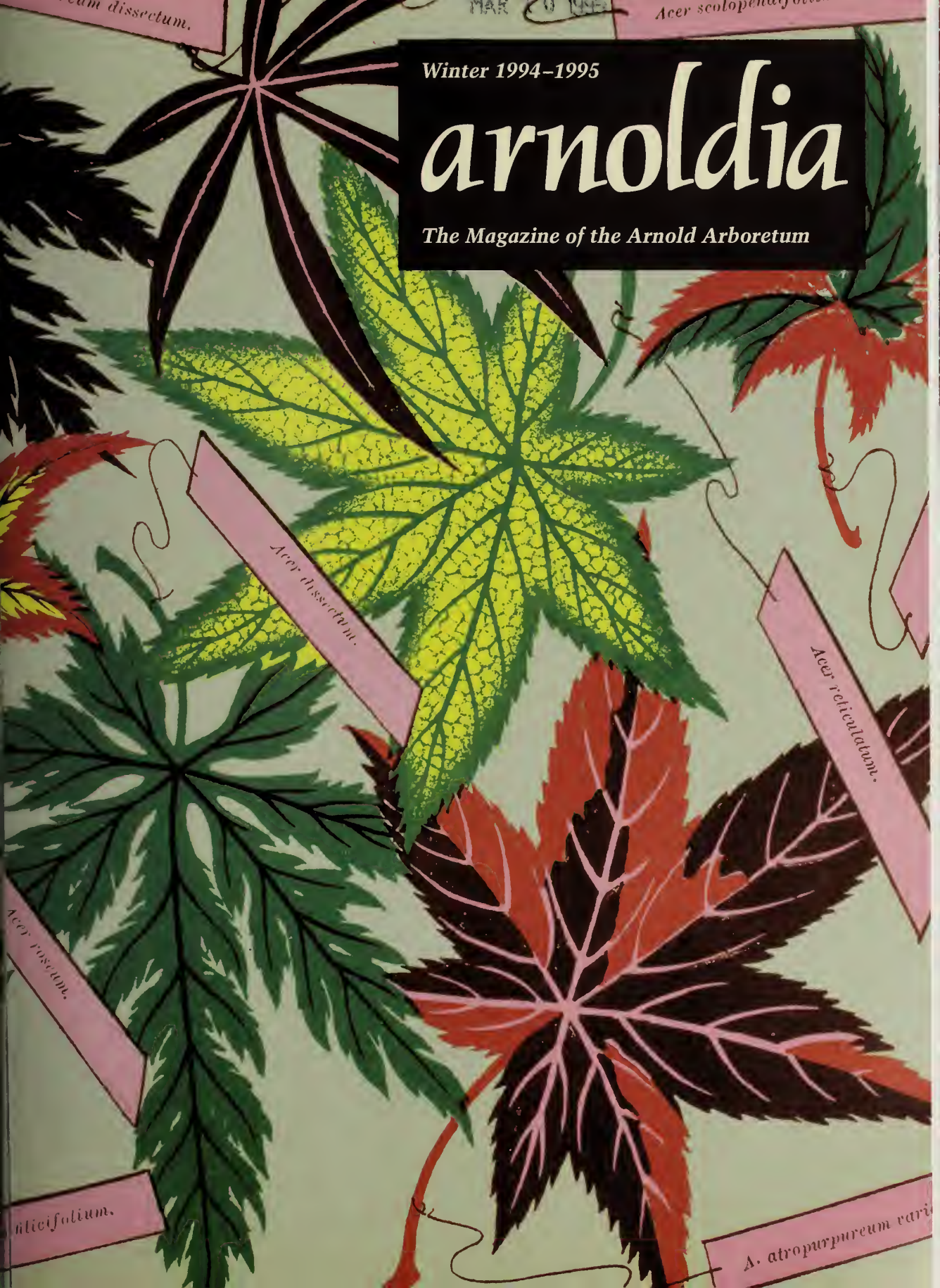
In a related vein, it is worth noting the recent publication of the final two volumes of Theophrastus' great work, the two-thousand-year-old *De Causis Plantarum.* Remarkably, this is the first publication of Books III through VI in English. (Volume 1, encompassing Books I and II, was published in 1976 as Loeb Library no. 471.)

Theophrastus, born around 370 BC, is the author of the most important botanical works that have survived from classical antiquity. He was in turn a student, collaborator, and successor of Aristotle at the Lyceum. Like his predecessor, he was interested in all aspects of human knowledge and experience, especially natural science. His writings on plants form a counterpoint to Aristotle's zoological works. Books II and IV of *De Causis Plantarum* covers techniques of cultivation and agricultural methods in ancient Greece, while Books V and VI take up plant breeding, diseases and other causes of death, and distinctive flavors and odors.

From The Greek Plant World.

For those interested in Theophrastus, the publication of these long-awaited books is cause for celebration. After two thousand years, it might even be called the publishing event of a lifetime.

Peter Del Tredici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Acer rosetum.
A. atropurpureum vari

PARADISI IN SOLE
Paradisus Terrestris.

or

A Garden of all sorts of pleasant flowers which our English ayre will permitt to be noursed vp:
with
A Kitchen garden of all manner of herbes, roots, & fruites, for meate or sause vsed with vs,
and
An Orchard of all sorte of fruitbearing Trees and shrubbes fit for our Land
together
With the right ordering planting & preserving of them and their vses & vertues
Collected by John Parkinson Apothecary of London.

1629

Qui veut parangonner l'artifice a Nature
Et nos parcs à l'Eden, mesure il mesure.

Le pas de l'elephant par le pas du ciron,
Et de Mipse le vol par cil du mouscheron,

A

arnoldia

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Arnoldia is set in Trump Mediaeval typeface.

A Sourcebook of Cultivar Names

Arthur O. Tucker, Scott G. Kunst, Freek Vrugtman, Laurence C. Hatch

Cover: An assortment of leaves of *Acer palmatum* and *japonicum* as illustrated in the 1901 catalog of the Yokohama Nursery Company. From the Archives of the Arnold Arboretum

Inside front cover: Frontispiece from John Parkinson's *Paradisi in sole paradisus terrestris* of 1629.

Inside back cover: Varieties of *Iris* as illustrated in *Paradisi in sole paradisus terrestris.*

Various roses as illustrated in Paradisi in sole paradisus terrestris *by John Parkinson, 1629.*

Preface

The process of selecting and naming cultivated plants is as old as human society itself, and the rise of civilization based on an agrarian society was in large measure dependent on the process. While plants of agricultural significance were the primary focus of attention, plants of strictly ornamental value were certainly not overlooked. Consequently, by 1629 John Parkinson (1567–1650) could author the first book devoted entirely to garden plants, *Paradisi in sole paradisus terrestris,* and enumerate the many variants that had been selected and perpetuated through propagation and cultivation in gardens. The tradition of documenting and describing cultivars has continued since Parkinson's time and in 1753 took—along with botanical nomenclature—a new turn with the introduction by Linnaeus of binomial nomenclature. It was at this point that the polynomial or phrase names used to refer to the different types of plants were replaced by a two-word name incorporating a generic name coupled with a specific epithet (for example, *Quercus alba,* our native white oak).

Subsequent to the time of Linnaeus, the plants intentionally selected by growers for a particular attribute or combination of attributes were accommodated within the botanical system of classification and named using the infraspecific ranks of *varietas* and *forma* (e.g., *Quercus robur* f. *fastigiata,* now *Q. robur* 'Fastigiata'). However, because it is these same ranks that botanists use to name naturally occurring variants in the world's spontaneous floras, ambiguity was inevitable. Did a particular varietal or forma name refer to a naturally occurring plant or to one selected for a combination of attributes and perpetuated only in cultivation by skilled propagators and knowledgeable gardeners?

As confusion mounted, it became necessary to establish two separate systems of nomenclature: one for botanists studying forms occurring in nature, and another for horticulturists selecting and naming plants for economic or ornamental value. With the publication in 1953 of the first edition of the *International Code of Nomenclature for Cultivated Plants* (W. T. Stearn, 1953, London: RHS) the term *cultivar,* which merged the two words "cultivated variety" into one, was officially introduced to the horticultural world, and the rules governing the naming of cultivars were formally divorced from the rules for naming botanical taxa. Henceforth, plants selected for unique attributes of horticultural importance were to be given so-called "fancy" names in the vernacular (e.g., *Magnolia grandiflora* 'Tulsa'), whereas botanical epithets at the species and infraspecific ranks would continue to employ names in Latin format (e.g., *Magnolia acuminata* var. *subcordata*). Additionally, the new "cultivated code" provided for the designation of national and international registration authorities that would serve as clearing houses for monitoring the use of cultivar names, thus insuring that their formation and application followed the recommendations of the *Code.*

A further responsibility of registration authorities stipulated by the *Code* was the development of master checklists of cultivar names. This involved accounting for the

literature pertaining to each group or genus from the time of Philip Miller's *The Gardeners Dictionary* (sixth edition, 1752) onward. The goal was to produce master checklists of cultivar names—in both Latin that predated the "cultivated code" and the vernacular—in order to stabilize cultivar nomenclature and to avoid duplication of names. At the same time, lists of known synonyms and standard references for a given group of cultivated plants would be developed.

Over the years since 1953, a great deal of progress has been made in attempts to achieve these goals, and literally thousands of new cultivars have been named and introduced into the worldwide horticultural marketplace. Locating these published names in the literature and finding descriptions and checklists, however, is often a daunting task for the uninitiated, and tracing elusive cultivar names frequently leads to a dead end.

In providing an up-to-date listing of cultivar checklists and the widely diverse literature in which cultivar names and pertinent descriptions and illustrations can be found, Professor Tucker and his coauthors have provided a great service to horticultural science as well as garden historians and landscape architects involved in historic landscape preservation. This listing, moreover, gives us an indication of where we have been in the past and provides the basis for documentation of future developments in ornamental horticulture. The wealth of information contained in this listing is a particularly welcome summary of work to date inasmuch as a new, fourth edition of the *International Code of Nomenclature for Cultivated Plants* is due to appear later this year. Professor Tucker and his coauthors are to be congratulated for this unique and useful contribution.

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Introduction

Gardeners have traditionally traded plants over the back fence. For many, identification beyond "grandmother's pink rose" is not needed. Others, however, want to know the correct name of the cultivar (a term derived from *cultivated variety*). Is your old white iris *Iris germanica* 'Alba', or is it really 'Albicans'?

An even more vexing problem is authenticating the identification of purchased plant materials from both mail-order and local nurseries. Nurseries receive plants under one name, often from a commercial grower, and are frequently slow to change. Is your 'Black Magic' iris correctly identified, or is it really 'Eleanor Roosevelt'? Have you purchased *Rosa damascena* 'Trigintipetala' because of its anticipated fragrance and light pink flowers but received instead a hybrid with no damask rose genes, dark pink flowers, and little fragrance? Correct identification of cultivars requires consultation of cultivar checklists and ultimately of period descriptions. This brings up another problem: who has published checklists of your favorite plant group?

Our initial interest in compiling a list of cultivar checklists was generated by work in historical restoration. The task was to locate pre–1900 cultivars of ornamentals and to verify them by cumulative checklists (Kunst and Tucker, 1989). We have since expanded this to an attempt to locate all cultivar checklists for ornamental plants. (Because these lists are often scattered and sometimes difficult to locate, we would appreciate any corrections and updatings.)

In the following, some historical checklists are included, but we have concentrated on the most recent, updated, cumulative ones. Our cut-off date of publication, with few exceptions, is January 1994.

The ideal checklist includes the name of the cultivar, the date of introduction (or registration), the name of the hybridizer, parentage, description, and colored photograph. Of course, this ideal is rarely achieved, especially in the older literature. For this reason, we have also included botanical and horticultural revisions when cultivars are described and illustrated. Good general references to extant cultivars are Harkness and D'Angelo (1986) and Hatch (1986). The Wisley Trials in the *Journal* and *Proceedings of the Royal Horticultural Society* are recommended for cultivar descriptions; Wright (1984) also discusses many cultivars.

Besides numerous cultivars in its "Cultivar & Germplasm Releases" section, *HortScience* has become the vehicle for publication of cultivar names for unassigned woody genera (Huttleston, 1986, 1988, 1989, 1990, 1991, 1992, 1993; Vrugtman, 1994), genera at the Arnold Arboretum (Spongberg, 1988, 1989, 1990, 1991, 1992, 1993, 1994a), *Kalmia* (Jaynes, 1989), and *Syringa* (Vrugtman, 1988, 1989a, 1989b, 1990a, 1991, 1994b). Listings of other cultivars are supposed to be maintained by International Registration Authorities (American Association of Nurserymen, c. 1987; Leslie, 1986; Schneider, 1986a; Vrugtman, 1972, 1973, 1977, 1981, 1984, 1985, 1986, 1989c, 1990b, 1990d). These

designated authorities are further supplemented by cumulative checklists and origination lists maintained and published by specialist societies.

The general starting point for valid publication of cultivar names is the sixth edition of Philip Miller's *The Gardeners Dictionary* (1752). The rules for naming cultivars are covered by Brickell (1980) and Greuter (1988). The American Association of Nurserymen (c. 1987) and Allan (1988) have published guides for the public.

A recent problem that may confuse efforts to stabilize cultivar names is the substitution of trademarks. The statement by the AAN that "under Federal law, plant variety (cultivar) names may not be trademarked" actually runs counter to the current practice in some large wholesale North American nurseries. For example, many horticulturists know the trademarked name *Ilex* China Girl™ but have never heard of 'Mesog', its registered cultivar name. Even the prestigious *Modern Roses 10* (Cairns, 1993) does not list 'Wilwind', the cultivar name, but rather Windmill™. What, then, is the *real* cultivar name?

The Townsend-Purnell Plant Patent Act of 1930 provides a 17–year patent protection for asexually propagated cultivars, and the Plant Variety Protection Act of 1980 provides 18–year legal protection for sexually propagated cultivars in the United States. In order to circumvent this limitation of time, some nurseries have resorted to trademark names (Chadwick, 1988; Darke, 1991, 1992; Dates and Luby, 1988; E. McClintock, personal communication, 1990; Royon, 1986). While this is allowed by the *International Code of Nomenclature for Cultivated Plants* (Brickell, 1980), with this practice different cultivars may be substituted under the same trademark name from year to year. Although we understand the monetary reason for using trademark names, we must chastise the nursery industry for creating a vast confusion in the process, and no solution is envisioned for the immediate future.

Ultimately, after having spent good money for 'Munstead' lavender because of its association with Gertude Jekyll, it is disappointing to consult the checklists and realize that you have really purchased 'Compacta'. Errant nursery cataloguers will only be corrected by gardeners who insist on correct labelling for their money.

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Checklist of Cultivars

Abies See conifers.

Acacia See Australian & South African plants.

Acer Cultivars of maples are listed by Bean (1970–1988), Bom (1982), Grootendorst (1969a), Harris (1983), Krüssmannn (1984–1986), Mulligan (1958), Murray (1970), Schwerin (1919), and Weaver (1976b). The cultivars of the vine maple (*A. circinatum* Pursh) are discussed by Vertrees (1979). Cultivars of red maple (*A. rubrum* L.), sugar maple (*A. saccharum* Marsh.), Norway maple (*A. platanoides* L.), and silver maple (*A. saccharinum* L.) are listed by Santamour & McArdle (1982a, 1982b, 1982c, 1982d). The cultivars of Japanese maple (*A. palmatum* Thunb.) are thoroughly documented by Harris (1982) and Vertrees (1978, 1987) with color photographs. Additional recent registrations are recorded in Huttleston (1986, 1989).

Achimenes See Gesneriaceae.

Aconitum Some of the cultivars of the monkshoods are listed by Lord (1988) and Müssel (1986).

Adiantum See ferns.

Adonis Cultivars of *Adonis amurensis* Regel & Radde are discussed by Nakamura (1964).

Aeschynanthus See Gesneriaceae.

Aesculus The cultivars of the horsechestnuts are discussed by Bean (1970–1988), Grootendorst (1967a), Krüssmannn (1984–1986), and Wright (1985).

Agonis See Australian & South African plants.

Agapanthus The cultivars of the Nile lilies are discussed in the Wisley Trials of 1977 (Royal Horticultural Society, 1978).

Aglaonema The cultivars of the Chinese evergreens are listed by Jervis (1980).

Allium The few ornamental cultivars of *Allium*, the onions, are listed by Davies (1992).

Alnus Cultivars of the alders are listed by Ashburner (1986) but without introduction dates or background. Grootendorst (1972a) and Schneider (1965a) also discuss the cultivars of alders. An additional registration of *Alnus* is recorded by Huttleston (1988). Cultivars of *Alnus* are also discussed by Bean (1970–1988) and Krüssmann (1984–1986).

Aloe The South African Aloe Breeders Association has circulated an unpublished list of *Aloe* cultivars (for example, 1987), and many cultivars are published in *Aloe* and other South African journals.

Alsobia See Gesneriaceae.

Alyssum The cultivars of the alyssums are discussed by Dudley (1966).

Amaryllidaceae Traub & Hannibal (1960) list the cultivars of *Brunsvigia* with later additions published in *Plant Life*. Traub (1961) lists the cultivars of x *Crinodonna* with later additions in *Plant Life*. Kelsey & Dayton (1942) and Anonymous (1958f) are the first to list the cultivars of the garden amaryllis, *Hippeastrum*, but the most comprehensive list is by Traub et al. (1964) with subsequent registrations in *Plant Life*. The nerines are listed by Kelsey & Dayton (1942),

the Royal General Bulbgrowers' Association (1991), and Smithers (1993), but the most comprehensive lists are Menninger (1960), Roberts (1984), and Smee (1984) with later additions in editions of *Plant Life*.

Amelanchier A checklist of ornamental and fruiting shadbush cultivars is Hilton (1982, 1984). Krüssmann (1984–1986) also lists cultivars.

Anigozanthos See Australian & South African plants.

Anemone Many cultivars of *Anemone* are listed by Trehane (1989). The cultivars of *A. nemorosa* L. are listed by the Royal General Bulbgrowers' Association (1991) and Toubøl (1981). The history and performance of cultivars of *Anemone japonica* (Thunb.) Sieb. & Zucc. are discussed by Clausen (1972a) and Hensen (1968, 1979).

Antirrhinum The cultivars and performance of the snapdragons are listed by the Royal Horticultural Society (1913b).

Arctostaphylos The cultivars of the bearberries and manzanitas are recorded by Keeley & Keeley (1994).

Ardisia The Japanese cultivars of *Ardisia japonica* (Hornst.) Blume, the marlberry, are discussed by Yinger & Hahn (1985).

Argyranthemum The cultivars of the marguerite are compared and contrasted with studio photographs by Cheek (1993).

Aster The most comprehensive lists of the cultivars of the asters are by Meier (1973a, 1973b, 1973c, 1973d) and Jensma (1989); the latter is being expanded and revised. Kelsey & Dayton (1942), Royal Horticultural Society (1902, 1908a, 1926a), and Trehane (1989) discuss the cultivars of the hardy asters, but these are published without introduction dates or background. Ranson (1946) lists mostly species with few cultivars. The history and performance of cultivars of the asters are discussed by Allen (1983), Clausen (1973a), and Jelitto & Schacht (1990). Barret (1959) discusses the performance of cultivars of *A. ericoides* L.

Astartea See Australian & South African plants.

Astilbe The most comprehensive published list of *Astilbe* cultivars is Ievinya & Lusinya (1975) with c. 170 cultivars, detailed descriptions of c. 50, and an extensive bibliography. Hensen (1969) discusses the history and performance of species and cultivars of *Astilbe*. Jelitto & Schacht (1990), the Royal Horticultural Society (1970b), Schneider (1968), and Trehane (1989) also list cultivars of *Astilbe*.

Aubrieta The cultivars of *A. columnae* Guss., *A. deltoidea* (L.) DC., and *A. intermedia* Heldr. & Orph. are thoroughly discussed by Clausen (1973c) and Hensen (1976). Jelitto & Schacht (1990) and Trehane (1989) also list cultivars of *Aubrieta*.

Australian & South African plants The Australian Cultivar Registration Authority has circulated a continually updated list (for example, 1988) of registered cultivars of *Acacia, Agonis, Anigozanthos, Astartea, Baeckea, Banksia, Baura, Blechnum, Boronia, Brachychiton, Brachycome, Callistemon, Callitris, Ceratopetalum, Chamelaucium, Correa, Crowea, Epacris, Eremophila, Eriostemon, Eucalyptus, Eucryphia, Grevillea, Hakea, Hardenbergia, Helichrysum, Hypocalymma, Kennedia, Kunzea, Lechenaultia, Leptospermum, Lophostemon, Melaleuca, Myoporum, Pandorea, Pimelea, Plectranthus, Prostanthera, Pultenaea, Scaevola, Spyridium, Telopea,* and *Tetratheca.*

Baeckea See Australian & South African plants.

Banksia See Australian & South African plants and Proteaceae.

Baura See Australian & South African plants.

Begonia The most comprehensive checklist of begonias is Ingles (1990). This should be supplemented with Kelsey & Dayton (1942), Thompson (1976–1978, 1984), and Thompson & Thompson (1980, 1982). Cultivars of *B. semperflorens*-cultorum hybrids are published by Maatsch (1962), Maatsch & Nolting (1969, 1971a), and Nolting & Zimmer (1975a, 1980a, 1985, 1987). Cultivars of tuberous begonias are listed by Haegeman (1978, 1979) and Langdon (1969). Cultivars of other begonias are published by the American Begonia Society (1957, 1958, 1962, 1967, 1985). Registrations in *The Begonian* are summarized by Vrugtman (1972). These should be used in conjunction with Japan Begonia Society (1980), Misono (c. 1974–1978), and Thompson & Thompson (1981).

Berberis Schneider (1923) covers the publication history and descriptions of cultivars of the barberries. The cultivars of the barberries are also listed by Ahrendt (1942, 1949, 1961), Krüssmann (1984–1986), Laar (1972), and Wyman (1962b).

Bergenia The cultivars of the bergenias are discussed by Beckett (1983), Laar (1973), and Yeo (1971a, b).

Betula Cultivars of the birches are listed by Ashburner (1980), Fontaine (1970a), Grootendorst (1973a), Jong (1986), Santamour & McArdle (1989), and Wyman (1962c). Cultivars of *Betula* are also discussed by Bean (1970–1988) and Krüssmann (1984–1986).

Blechnum See ferns.

Boronia See Australian & South African plants.

Bougainvillea The most comprehensive discussions of cultivars of bougainvillea are Choudhury & Singh (1981) and MacDaniels (1981). Previous checklists are Anonymous (1959c) and Gillis (1976). Subsequent registrations are recorded by Singh (1986).

Brachychiton See Australian & South African plants.

Brachycome See Australian & South African plants.

Bromeliaceae A preliminary checklist of bromeliad cultivars has been prepared by Beadle (1991) and the Bromeliad Society (1989).

Brunsvigia See Amaryllidaceae.

Bucinellina See Gesneriaceae.

Buddleja The cultivars of the butterfly bushes are listed by Leeuwenberg (1979) but without dates of introduction or hybridizers. Cultivars of the butterfly bushes are also discussed by Bean (1970–1988), Grootendorst (1972b), and Krüssmann (1984–1986).

Bulbs The cultivars of many hardy and tender bulbs are published by the Royal General Bulbgrowers' Association (most recent is 1991). Many cultivars are also listed in Trehane (1989).

Buxus A guide for registration and documentation of cultivar names of *Buxus* is provided by Dudley & Eisenbeiss (1971). The cultivars of boxwood are listed by Bean (1970–1988), Batdorf (1987, 1988), Krüssmann (1984–1986), and Wagenknecht (1965, 1967, 1971, 1972).

Cactaceae Cultivars of many succulents, including cacti, are listed by Jacobsen (1977). The cultivars of *Epiphyllum*, the orchid cacti, are thoroughly discussed by Rainbow Gardens (1979), along with cultivars of *Epiphyllum* x *Aporocactus*. This should be supplemented with

Hashizume (c. 1982–1985), who provides good color photographs and English captions in his guide to taxa of *Epiphyllum;* additional color photographs are presented by Leue (c. 1987). The cultivars of *Schlumbergera* are discussed by Horobin (1985).

Caladium The cultivars of the caladiums are evaluated for landscaping by Wilfret (1984).

Callistemon See Australian & South African plants.

Callistephus The cultivars of the China aster, *C. chinensis* (L.) Nees, are assembled into checklists by Maatsch (1958, 1964), Maatsch & Nolting (1971c), Nolting & Zimmer (1975c, 1981, 1987), and Olmsted et al. (1923).

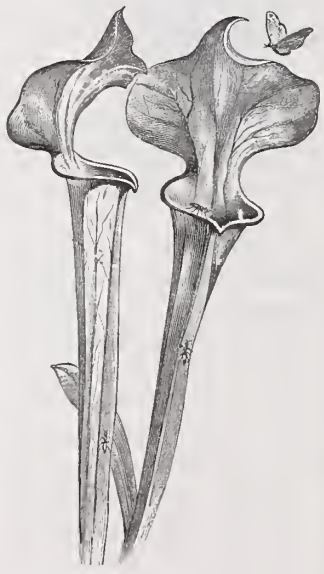
Callitris See Australian & South African plants.

Calluna A guide to naming heather cultivars is McClintock (1986). Bean (1970–1988), Chapple (1951), Johnson (1956), Krüssmann (1984–1986), Laar (1968, 1970a, 1974, 1977a), Letts (1966), Proudley & Proudley (1974), and Underhill (1990) list many cultivars of heathers. Munson (1981, 1984) provides a comprehensive key to the species and cultivars of *Calluna* with full botanical descriptions in the 1981 thesis.

Camellia Bean (1970–1988), Durrant (1982), Erdman (1949), Gerbing (1945), Hertrich (1954–1959), Hume (1955), Krüssmann (1984–1986), Macoboy (1981), and Sharp (1957) list many cultivars of camellias, but Woodroff & Donnan (1990) is probably the best compact checklist, while Savige (1993) is probably the most complete list with 41,000 cultivars. The Japanese cultivars of camellias are listed by Tuyama (1968), while the Chinese cultivars are listed by the Kunming Institute of Botany, Academica Sinica (1986). The International Camellia Society expects to publish the International Camellia Register.

Campanula The history and performance of cultivars of the bellflowers are discussed by Clausen (1976) and Lewis & Lynch (1989). Trehane (1989) also lists the cultivars of the bellflowers.

Canna Kelsey & Dayton (1942) has published a list of canna cultivars without dates and hybridizers. Additional information is given by the Royal General Bulbgrowers' Association (1991), Royal Horticultural Society (1908b, 1909), and Trehane (1989). Mukherjee & Khoshoo (1970) provide botanical characteristics of many cultivars.



Capsicum The peppers are sometimes grown as ornamentals (e.g., 'Fips'), and Andrews (1984) records extensive information on these cultivars in her monumental book.

Carnivorous plants Named cultivars of *Drosera, Nepenthes,* and *Sarracenia* are listed by Schlauer (1986, 1987; note that the first list neglects to capitalize the cultivars) and Kusakabe (1987). Additional cultivars of *Sarracenia* are later listed by Mellichamp & Gardner (1987). The hybrids of *Nepenthes* are reported by Fleming (1979). Fleming's list is reprinted in Pietropaolo & Pietropaolo (1986). An additional cultivar of *Nepenthes* is listed by Robinson (1989).

Carpinus Cultivars of *Ostrya,* the hop hornbeams, and *Carpinus,* the hornbeams, are discussed by Rushforth (1985), Schneider (1965a), and Wright (1986). Cultivars of *Carpinus* and *Ostrya* are also discussed by Bean (1970–1988) and Krüssmann (1984–1986).

Castanea The cultivars of the potentially blight-resistant chestnuts are discussed by Jaynes & Graves (1963) and Nienstaedt & Graves (1955).

Ceanothus Van Rensselaer & McMinn (1942) provide the most comprehensive listing of the wild-lilacs and buckrushes. Additional cultivars are listed by Bean (1970–1988), Hogan (1988),

Huttleston (1986), Keeley & Keeley (1994), Krüssmann (1984–1986), Schmidt (1962), and Smith (1979).

Ceratopetalum See Australian & South African plants.

Cercis The cultivars of the redbuds are discussed by Raulston (1990).

Chaenomeles The cultivars of the Japanese quinces are listed by Bean (1970–1988), Grootendorst (1968a), Krüssmann (1984–1986), and Weber (1963).

Chamelaucium See Australian & South African plants.

Chrysanthemum See *Argyranthemum* for the marguerite and *Dendranthema* for the florist's chrysanthemum.

Cistus The cultivars of the rock roses are discussed by Bean (1970–1988), Warburg (1931), and Warburg & Warburg (1930).

Citrus The cultivars of *Citrus*, some ornamental, are listed by Hodgson (1967).

Clematis A general clematis checklist is Lloyd (1965, 1989); Fretwell (1989) provides good color photographs. The cultivars of *C. viticella* L. are listed by Rogerson (1985). The large-flowered clematis hybrids are published by Evison (1985) and Spingarn (1935), while the hybrids of section *Atragene* are published by Pringle (1973). Kelsey & Dayton (1942) also provide a list of *Clematis* but without introduction dates and background. Some cultivars are also published by Laar (1985), Markham (1935), and Trehane (1989).

Codiaeum The list for the garden croton, *Codiaeum variegatum* (L.) Blume, of Kelsey & Dayton (1942) provides no introduction dates or background. Additional cultivars are listed by Anonymous (1959a) and Brown (1960). The latter provides good color illustrations but also includes a number of botanical errors.

Coleus-Plectranthus While no proper checklist exists for coleus cultivars, Pedley & Pedley (1974) and Stout (1916) provide many materials for the production of such a list. Recent registrations of *Plectranthus* are listed by the Australian Cultivar Registration Authority (1988).

Columnea See Gesneriaceae.

Conifers Lewis (1986a, b) provides a guide for the naming of conifer cultivars. The Royal Horticultural Society has started an ambitious registry of conifers; so far *Abies* to *Pherosphaera* have been published (Lewis, 1985; Lewis & Leslie, 1987, 1989). Meanwhile, Welch & Haddow (1993) have published a world checklist of conifers. Den Ouden & Boom (1978) and Krüssmann (1985) present the cultivated conifers with introduction dates and descriptions, while Cope (1986) provides scant information on dates or origins. Welch (1991) is an updating of both den Ouden & Boom (1978) and Welch (1979). Many cultivars of conifers are also listed by Bean (1970–1988). Munson (1973) has prepared a vegetative key to dwarf and slow-growing conifers, while Obrizok (1991) provides growth forms of dwarf conifers. The cultivars of the firs (*Abies* spp.) and spruces (*Picea* spp.) are listed by Gelderen (1975). Silver firs, *Abies alba* Mill., are discussed by Horsman (1984). Japanese cedar, *Cryptomeria japonica* (L. f.) G. Don, cultivars are treated by Kortmann (1987) and Tripp (1993). Juniper (*Juniperus* spp.) cultivars are listed by Gelderen (1984) and Grootendorst (1968c). Pine (*Pinus* spp.) cultivars are listed by Gelderen (1982), while the cultivars of Japanese five needle pine, *P. parviflora* Sieb. & Zucc., are listed by Valavanis (1976). The cultivars of yews, *Taxus*, are listed by Chadwick & Keen (1976). The cultivars of American arborvitae, *Thuja occidentalis* L., are listed by Grootendorst (1971b), while Wyman

(1961c) discusses cultivars of four arborvitae species. Hemlock (*Tsuga* spp.) cultivars are documented in Swartley (1984). These should be supplemented with the color photographs of Harrison (1975) and Gelderen & van Hoey Smith (1986) and the black and white photographs of Welch (1979).

Cordyline A list for the cultivars of the ti, *Cordyline terminalis* (L.) Kunth, is Kelsey & Dayton (1942) but without introduction dates and background. Additional cultivars are listed by Anonymous (1959d).

Cornus Cultivars of the dogwoods are listed by Bean (1970–1988), Howard (1961), Krüssmann (1984–1986), and Santamour & McArdle (1985a). Jaynes, Brand, & Arnow list the cultivars of the kousa or Japanese dogwood, *C. kousa* Hance. Additional registrations are recorded by Spongberg (1988, 1990).

Correa See Australian & South African plants.

Corylus Bibliographic references to the cultivars of the filberts are recorded by Debor (1978).

Cosmos The Indian cultivars of cosmos are listed by Anonymous (1959b).

Cotoneaster The cultivars of the rock sprays are treated by Bean (1970–1988), Grootendorst (1966a), Hachmann et al. (1987), and Krüssmann (1984–1986).

Crataegus Wyman (1962d) lists the cultivars of the hawthorns but with few introduction dates and little background. Bean (1970–1988), Grootendorst (1967c), and Krüssmann (1984–1986) also discuss the cultivars of the hawthorns.

x ***Crinodonna*** See Amaryllidaceae.

Crinum The cultivars of the spider lilies are listed by Hannibal (1970–71).

Crocosmia The cultivars of the montbretias are listed by Kostelijk (1984).

Crocus The cultivars of crocus are documented by the Royal General Bulbgrowers' Association (1991), but further information is provided by Ruksans (1981) and Trehane (1989).

Crowea See Australian & South African plants.

Cryptomeria See conifers.

Cyclamen Some cultivars of *Cyclamen* are recorded by Grey-Wilson (1988), the Royal General Bulbgrowers' Association (1991), Trehane (1989), and Wellensiek (1961), while a comprehensive list of cultivars is Wellensiek et al. (1961).

Cytisus The cultivars of the brooms (*Cytisus* and *Genista*) are treated by Bean (1970–1988), Krüssmann (1984–1986), and Laar (1971).

Daboecia *Daboecia* cultivars are included in many listings of heaths and heathers (e.g., Johnson, 1956; Munson, 1981; Underhill, 1971), and separately by Bean (1970–1988), Krüssmann (1984–1986), and Laar (1977b).

Dahlia The most comphrehensive checklist of dahlias is that of the Royal Horticultural Society (1969a) and later supplements (1988d, 1989c, 1992a). Unfortunately, with one exception (a cultivar from 1850), this list omits all cultivars 1789–1859 and many of the cultivars 1860–1900. Many early twentieth-century cultivars are amply covered in Norton (1924), Olmsted et al. (1923), and Sandhack (1927). Recent cultivars are listed by the American Dahlia Society (e.g., 1989) in a paperbound booklet as a supplement to the *Bulletin of the American Dahlia Society.*

Dalbergaria See Gesneriaceae.

Daphne The cultivars of *Daphne* are listed by Brickell & Mathew (1976). Bean (1970–1988), Hodgkins (1961), and Krüssmann (1984–1986) also discuss the cultivars of *Daphne*.

Delphinium The Royal Horticultural Society (1970a) is a checklist of delphinium names that updates a list previously published in 1949. International registration of delphinium cultivars is handled by the Delphinium Society (Cooper, 1984, 1986, 1987, 1989, 1990b, 1991, 1992, 1993, 1994). Edwards (1987) and Trehane (1989) are recent lists of cultivars. Bishop (1949), Cooper (1990a), Edwards (1989), Genders (1963a), Jelitto & Schacht (1990), Ogg (1961), and the Royal Horticultural Society (1926e) also list many cultivars. Kelsey & Dayton (1942) also lists delphiniums but without introduction dates and background.

Dendranthema The cultivars of *D.* x *grandiflorum* (Ramat.) Kitamura, or florist's chrysanthemum, are first listed by Olmsted et al. (1923) and Kelsey & Dayton (1942). These lists omit all cultivars 1789–1889. Cumming (1964) presents some history. Scott & Scott (1950) are also recommended for early cultivars and hybridizers. Additional cultivars are listed by Gosling (1964, 1973b, 1980) and the [U.S.] National Chrysanthemum Society (1991). Genders (1961), Gosling (1973a), Jelitto & Schacht (1990), and Trehane (1989) also list some cultivars. Niwa (1936) should be consulted for Japanese cultivars.

Desmodium The cultivars of the tick trefoils are listed by Lemmens (1985).

Deutzia The cultivars of the deutzias are discussed by Bean (1970–1988) and Krüssmann (1958b).

Dianthus The Royal Horticultural Society has published the international register for pinks and carnations (1983) with supplements (1984b, 1985b, 1986b, 1988b, 1988c, 1989b, 1990a), which supersede the 1974 list. These lists are very comprehensive, but American cultivars (such as 'Aqua') are slow to be integrated. These checklists should be used in conjunction with Bailey (1990), Mansfield (1951), Sitch (1975), and Smith (1990). The history and performance of *D. gratianopolitanus* Vill. and *D. plumarius* L. are discussed in Hensen (1981). Kelsey & Dayton (1942) include American carnation cultivars. Jelitto & Schacht (1990) and Trehane (1989) also list many cultivars of perennial *Dianthus*.

Diastema See Gesneriaceae.

Diervilla The cultivars of the bush honeysuckles are discussed by Schneider (1930).

Dracaena The Indian cultivars of the dracaenas are listed by Anonymous (1959d).

Drosera See carnivorous plants.

Echeveria Carruthers & Ginns (1973) list cultivars of *Echeveria* but provide no dates.

Epacris See Australian & South African plants.

Epimedium The cultivars of the epimediums are listed by Laar (1981a).

Epiphyllum See Cactaceae.

Episcia See Gesneriaceae.

Eremophila See Australian & South African plants.

Erica A guide to naming heath cultivars is McClintock (1986). Bean (1970–1988), Chapple (1951), Johnson (1956), Krüssmann (1984–1986), Laar (1970a, 1977a), Letts (1966), Proudley & Proudley (1974), Underhill (1990), and Laar (1974) list many cultivars of

heaths. Munson (1981, 1984) provides a comprehensive key to species and cultivars of *Erica* with full botanical descriptions in the 1981 thesis.

Erigeron The history and performance of cultivars of the daisy fleabanes are discussed by Clausen (1972b), Hensen (1966), Jelitto & Schacht (1990), and Oudshoorn (1975). Trehane (1989) also lists many cultivars of the daisy fleabanes.

Eriostemon See Australian & South African plants.

Erodium The cultivars of the heron's bills are listed by the British Pelargonium and Geranium Society (1970).

Erythrina The species and cultivars of *Erythrina* are listed by McClintock (1982).

Escallonia The cultivars of the escallonias are listed by Bean (1970–1988), Krüssmann (1984–1986), and Schneider & Laar (1970).

Eucalyptus See Australian & South African plants.

Eucodonia See Gesneriaceae.

Eucryphia The cultivars of *Eucryphia* are discussed by Wright (1983a) but with no introduction dates or background. Bean (1970–1988) and Krüssmann (1984–1986) also list some cultivars. Recent registrations are listed by the Australian Cultivar Registration Authority (1988).

Euonymus The cultivars of *Euonymus* are discussed by Bean (1970–1988), Ilsink & Jong (1986), Krüssmann (1984–1986), Laar (1979), and Lancaster (1981). An additional registration is recorded by Huttleston (1986).

Euphorbia Ecke (1976) lists cultivars of the poinsettia, *Euphorbia pulcherrima* Willd. ex Klotzsch. Additional registrations are recorded by Huttleston (1989). Trehane (1989) and Turner (1983) discuss the cultivars of the hardy spurges.

Fagus Wyman (1962a, 1964) lists the cultivars of the beeches but with few introduction dates and little background. Bean (1970–1988), Grootendorst (1975), and Krüssmann (1984–1986) also discuss the cultivars of the beeches. Spongberg (1988, 1989) records additional registrations.

Ferns Maatsch (1980) lists cultivars of ferns with descriptions, background information, and English vernacular names. Jones (1987) and Mickel (1994) list many cultivars of ferns. The cultivars of *Adiantum*, maidenhair ferns, are listed in Goudey (1985). The cultivars of the staghorn ferns, *Platycerium*, are listed by Vail (1984). The cultivars of the royal ferns, *Osmunda regalis* L., are listed by Anderson (1971). Recent registrations of *Blechnum* are listed by the Australian Cultivar Registration Authority (1988).

Forsythia The cultivars of the forsythias are published by Bean (1970–1988), Hebb (1971), Krüssmann (1984–1986), Werken (1988), and Wyman (1961a, 1961b). Spongberg (1988) records additional registrations.

Fraxinus The cultivars of the ashes are discussed by Bean (1970–1988), Bom (1982), Grootendorst (1966b), Krüssmann (1984–1986), McArdle & Santamour (1984), and Santamour & McArdle (1983c).

Fuchsia Parker (1986) provides a guide for fuchsia cultivar identification. A comprehensive checklist of cultivars of fuchsias is Boullemier (1975, 1980, 1982, 1985). Bean (1970–1988) and Krüssmann (1984–1986) discuss some hardy cultivars. Ewart (1982, 1987) and Saunders (1971–

1973) describe and picture many of these cultivars. These should be used in conjunction with Manthey (1990), Proudley (1975), and Thorne (1959).

Gaillardia The cultivars and performance of the gaillardias are listed by the Royal Horticultural Society (1930c).

Galanthus The cultivars of the snowdrops are listed by Bowles (1956), the Royal General Bulbgrowers' Association (1991), Trehane (1989), and Yeo (1975).

Genista The cultivars of the brooms (*Cytisus* and *Genista*) are treated by Bean (1970–1988), Krüssmann (1984–1986), and Laar (1971).

Gentiana Bartlett (1975) includes many cultivars of gentians in her book. Many cultivars are also listed by Trehane (1989).

Geranium The history and performance of cultivars of the hardy geraniums are discussed by Clausen (1974b). Yeo (1985) includes information on many cultivars of the hardy geraniums in his comprehensive book. Clifton (1992), Jelitto & Schacht (1990), Trehane (1989), and Walsweer (1988) list many cultivars.

Gesneriaceae Cultivars of *Achimenes*, the orchid pansies, are listed by the American Gesneria Society (1957), Arnold (1969), and Townsend (1984). Cultivars of *Aeschynanthus* are listed by Dates (1990). Cultivars of *Columnea* and allied genera (*Bucinellina, Dalbergaria, Pentadenia,* and *Trichantha*) are listed by Arnold (1963b, 1966) and Dates (1987). Cultivars of *Episcia* and *Alsobia*, the carpet plants, are listed by the American Gesneria Society (1957), Arnold (1963a, 1968, 1977), and Dates (1993). Cultivars of *Kohleria*, the tree gloxinias, and *Smithiantha* are listed by the American Gesneria Society (1957), the American Gloxinia Society (1962), Batcheller (1985), and Moore (1953). Cultivars of *Nematanthus* are listed by Arnold (1978). The master variety lists for *Saintpaulia*, the African violets, are published by Boland (1983, 1984, 1985, 1986, 1987, 1988), Frank (1975), Rector (1963), and Tretter (1976) and should be supplemented with Kawakami (c. 1981), who includes English captions and a Japanese text with color photographs. Cultivars of *Sinningia* are listed by Arnold (1975) and Dates (1988). Cultivars of *Streptocarpus*, the Cape primroses, are listed by Arnold (1972, 1979) and Brown (1973). Intergeneric hybrids in the tribe Gloxinieae (which includes *Achimenes, Diastema, Eucodonia, Gloxinia, Heppiella, Koellikeria, Kohleria, Monopyle, Moussonia, Niphaea, Parakohleria, Smithiantha,* and *Solenophora*) are listed by Dates (1986).

Geum The history and performance of cultivars of *Geum* are discussed by Clausen (1975) and Mallett (1983). Jelitto & Schacht (1990) and Trehane (1989) also list many cultivars.

Ginkgo The cultivars of ginkgo (*G. biloba* L.) are discussed by Bean (1970–1988), Bom (1982), Krüssmann (1984–1986), and Santamour, He, & McArdle (1983).

Gladiolus Pieters (1905) is the first list of cultivars of gladiolus that we have discovered. The cultivars of gladiolus are later listed by Hottes (1916), Olmsted et al. (1923), the American Gladiolus Society (1931), Birch (1940), Pridham (1932), the Royal General Bulbgrowers' Association (1991), Sandhack (1927), and Trehane (1989). Many of these cultivars are incorporated into Fisher et al. (1975). Additions are published by Fisher (c. 1983).

Gleditsia Bean (1970–1988), Bom (1982), Haserodt & Sydnor (1983), Krüssmann (1984–1986),

Santamour & McArdle (1983b), and Wagenknecht (1961a) discuss the cultivars of the honey locust (*G. triacanthos* L.).

Gloriosa Narain (1988), the Royal General Bulbgrowers' Association (1991), and Trehane (1989) list cultivars of the climbing lilies.

Gloxinia See Gesneriaceae.

Grevillea The grevilleas are discussed by Larkman (1985). Recent registrations are listed by the Australian Cultivar Registration Authority (1988). See also the entry for Proteaceae.

Hakea See Australian & South African plants and Proteaceae.

Halesia The cultivars of the silverbells are listed by Fontaine (1970b).

Hamamelidaceae The cultivars of the Hamamelidaceae are discussed by Bean (1970–1988), Krüssmann (1984–1986), Sanders (1982), Weaver (1976a), and Wright (1982). Grootendorst (1965, 1980a) and Lancaster (1970) record the background and performance of witch hazel (*Hamamelis* spp.) cultivars. Huttleston (1989) records an additional registration of *Hamamelis*.

Hardenbergia See Australian & South African plants.

Hebe Chalk (1988) lists cultivars of *Hebe* and *Parahebe*. Bean (1970–1988) and Krüssmann (1984–1986) also discuss the cultivars of these two genera.

Hedera The most comprehensive listing of cultivars of ivies is Heieck (1980). This should be supplemented with Fearnley-Whittingstall (1992), Hatch (1982), Krüssmann (1984–1986), Lawrence & Schulze (1942), Lawrence (1956), Nannenga-Bremekamp (1970), Pierot (1974), Rose (1980), Schaepman (1975), and publications in the *Ivy Journal*.

Hedychium The cultivars of the ginger lilies are discussed by Schilling (1982).

Hedysarum The cultivars of the *Hedysarum* species are listed by Lemmens (1985).

Helianthemum The history and performance of cultivars of the rock roses are discussed by Clausen (1968) and the Royal Horticultural Society (1926d). Jelitto & Schacht (1990) and Trehane (1989) also list cultivars.

Helianthus The history and performance of cultivars of the sunflowers are discussed by Clausen (1974c). Trehane (1989) also lists cultivars.

Helichrysum See Australian & South African plants.

Heliconia The cultivars of *Heliconia* are discussed by Berry & Kress (1991).

Heliopsis The history and performance of cultivars of *Heliopsis* are discussed by Clausen (1974a) and Hensen (1983b). Jelitto & Schacht (1990) and Trehane (1989) also list cultivars.

Helleborus The cultivars of the hellebores are discussed and illustrated in black and white drawings by Ahlburg (1993) and appended to the rear of Mathew (1989b), but the most comprehensive descriptions, with color photographs, seem to be Rice & Strangman (1993).

Hemerocallis The daylilies are first listed by Stout (1934) and Norton et al. (1949), and later in publications of the American Hemerocallis Society (1957, c. 1973, c. 1984). The species and old cultivars are discussed by Kitchingham (1985). Jelitto & Schacht (1990) and Trehane (1989) also list cultivars. Additional information is provided by Munson (1989) and Webber (1988). These should be used in conjunction with Darrow & Meyer (1968), Erhardt (1992), and Stout (1986).

Heppiella See Gesneriaceae.

Heuchera The history and performance of the coralbells are discussed by Clausen (1970) and Hansen & Sieber (1970). Jelitto & Schacht (1990) and Trehane (1989) also list cultivars.

Hibiscus Krüssmann (1984–1986) discusses the cultivars of *Hibiscus*. The American Hibiscus Society (1984, 1987) and Chin (1986) are checklists and illustrated catalogs of cultivars of Chinese hibiscus (*H. rosa-sinensis* L.). Beers & Howie (1985, 1990), Harvey (1988), and Howie (1980) are checklists of mostly Australian cultivars of Chinese hibiscus. Cultivars of rose of Sharon (*H. syriacus* L.) are published by Bean (1970–1988), Grootendorst (1968b), Huttleston (1986, 1988, 1990, 1991), and Wyman (1958). Kelsey & Dayton (1942) provide a list of cultivars for both species but without introduction dates and background.

Hippeastrum See Amaryllidaceae.

Hoheria The cultivars of the lacebarks are listed by Bean (1970–1988), Krüssmann (1984–1986), and Wright (1983a).

Hosta The most comprehensive discussion of the hostas is Schmid (1991). The cultivars of the hostas are also listed in the comprehensive works by Hensen (1963a, 1963b, 1983a,1985) with comments by Grenfell (1986). These should be supplemented with Aden (1990), Fisher (1979), Grenfell (1990), Jelitto & Schacht (1990), Laar (1967), and Trehane (1989).

Houseplants Cultivars of houseplants are pictured and briefly discussed by Graf (1986a, 1986b).

Hyacinthus The cultivars of hyacinths are documented by the Royal General Bulbgrowers' Association (1991), but further information is provided by Darlington, Hair, & Hurcombe (1951). Trehane (1989) also lists the cultivars of hyacinths.

Hydrangea The most comprehensive discussion of the cultivars of the hydrangeas is Mallet, Mallet, & van Trier (1992). Cultivars of the hydrangeas are also covered in Bean (1970–1988), Grootendorst (1973b), Krüssmann (1984–1986), and Haworth-Booth (1984). Ilsink (1988) covers the cultivars of *H. paniculata* Sieb., while Wilson (1923) covers the cultivars of *H. macrophylla* (Thunb.) Ser.

Hypericum The cultivars of the St. Johnsworts are listed by Bean (1970–1988), Krüssmann (1984–1986), and Schneider (1965b, 1966a).

Hypocalymma See Australian & South African plants.

Ilex In 1953 the Holly Society of America published a preliminary checklist (Wister, 1953b). This checklist is being revised in accordance with the International Code of Nomenclature for Cultivated Plants. First in this series is Eisenbeiss & Dudley (1973) for *I. opaca* Aiton, the American holly. Eisenbeiss & Dudley (1983) is an *Ilex* cultivar registration list 1958–1983. Andrews (1983, 1984, 1986) and Gelderen (1988) discuss the cultivars of *I.* x *altaclerensis*. The varieties of *I. aquifolium* L. are listed in Gelderen (1988) and Paul (1863). Wyman (1960) and Dudley & Eisenbeiss (1992) are checklists for *I. crenata* Thunb. Dirr (1988) and Eggerss & Hasselkus (1992) cover the cultivars of the deciduous hollies. Bean (1970–1988), Gelderen (1971), and Krüssmann (1984–1986) also list the cultivars of the hollies. These should be used in conjunction with Hansell, Dudley, & Eisenbeiss (1970). New cultivars of hollies are published in the *Holly Society Journal*.

Impatiens The cultivars of the New Guinea impatiens are discussed by Agnew & Lang (1992), Eichin & Deiser (1988), and Winters (1973).

Indigofera The cultivars of the indigos are listed by Lemmens (1985).

Iris Jelitto & Schacht (1990) and Trehane (1989) list many cultivars of the hardy iris but with scant information. In contrast, the listings of cultivars of bearded irises published by Peckham (1929, 1940), Douglas (1949), Knowlton (1959), Nelson (1971), and Nelson & Keppel (1981, 1991, 1992a, 1992b, 1993) are rich with information. The Royal Horticultural Society (1928, 1930b) and Sand (1925) provide additional descriptions of many pre-1930 bearded irises. While the American Iris Society has published yearly checklists since the 1979 checklist, the 1989 checklist is still in press.

Cultivars of the reblooming iris are listed by Brookins (1991a). Cultivars of the dwarf irises are listed by the Dwarf Iris Society (1975, 1988) and Wright (1927). Cultivars of Japanese iris (*I. kaempferi* Sieb. ex Lem.) are published by Brookins (1992) and the Society for Japanese Irises (1988), supplemented by McEwen (1990). Cultivars of the Siberian irises (*I. sanguinea* Hornem. and *I. sibirica* L.) are listed by Brookins (1991b) and Warburton (1986). Cultivars of the arils are listed by the Aril Society (1976, 1978, 1980, 1982). The Louisiana irises are listed by Fritchie (1982), and some color photographs, dates, and background are given by Caillet & Metzweiller (1988). Cultivars of the medians are listed by the Median Iris Society (1984, 1992). Cultivars of the spurias are listed by Foreman (1985). Cultivars of the bulbous irises are discussed by Hoog (1980) and the Royal General Bulbgrowers' Association (1991).

Ixora Anonymous (1958c) is a checklist of the cultivars of the ixoras.

Jasminum The cultivars of the jasmines are discussed by Bean (1970–1988), Green (1965), and Krüssmann (1984–1986). An additional cultivar is listed by Huttleston (1986).

Juniperus See conifers.

Kalmia The cultivars of the mountain laurels are published in Jaynes (1975, 1983, 1988) and Krüssmann (1984–1986); additional cultivars are published in *HortScience* (Jaynes, 1989).

Kennedia See Australian & South African plants.

Kniphofia The cultivars of the torch lilies are discussed by Jelitto & Schacht (1990), Taylor (1985a, b), and Trehane (1989).

Koellikeria See Gesneriaceae.

Kohleria See Gesneriaceae.

Kunzia See Australian & South African plants.

Lagerstroemia The cultivars of crape myrtles are listed by Egolf & Andrick (1978) and Krüssmann (1984–1986).

Lantana The cultivars of the lantanas are listed by Anonymous (1958d), Howard (1969), and Krüssmann (1984–1986). An additional cultivar is recorded by Spongberg (1988).

Lathyrus Kelsey & Dayton (1942), Royal Horticultural Society (1926b), and Unwin (1926) are checklists of sweet peas, *Lathyrus odoratus* L. Cultivars of the hardy perennial species are listed by Trehane (1989).

Lavandula The cultivars of lavender (*L. angustifolia* Mill.) and lavandin (*L.* x *intermedia* Emeric ex Loisel.) are discussed by Hensen (1974), Krüssmann (1984–1986), and Tucker & Hensen (1985).

Lechenaultia See Australian & South African plants.

Leptospermum Krüssmann (1984–1986) and Metcalf (1963) are checklists of *Leptospermum* cultivars (mostly *L. scoparium* J. R. Forst & G. Forst). Recent registrations are listed by the Australian Cultivar Registration Authority (1988).

Lespedeza The cultivars of the bush clovers are listed by Lemmens (1985). An additional cultivar is listed by Huttleston (1991).

Leucadendron See Proteaceae.

Leucospermum See Proteaceae.

Leucothoë The cultivars of *L. fontanesiana* (Steud.) Sleum., the drooping leucothoë, are discussed by Bean (1970–1988), Krüssmann (1984–1986), and Green (1963).

Lewisia The cultivars of the lewisias are discussed by Mathew (1989a).

Ligularia The cultivars of *Ligularia* are discussed by Dress (1962).

Lilium Checklists of lilies are published by Leslie (1982) with supplements (Royal Horticultural Society, 1982, 1984a, 1985a, 1986a, 1987a, 1988a, 1989a, 1990b, 1991a, 1992b, 1993a, 1994). The North American Lily Society also has its checklists of lily hybrids (Fisher, 1978; Collings, 1986) but gives scant information on cultivars pre-1940. Additional listings are carried by Trehane (1989).

Liquidambar The cultivars of the the sweet gums (*L. formosana* Hance and *L. styraciflua* L.) are discussed by Bom (1982), Krüssmann (1984–1986), and Santamour & McArdle (1984).

Liriodendron The cultivars of the tulip tree (*L. tulipifera* L.) are discussed by Bean (1970–1988), Krüssmann (1984–1986), and Santamour & McArdle (1984).

Liriope See *Ophiopogon-Liriope.*

Lobelia The tetraploid cultivars of the *Lobelia siphilitica–L. cardinalis* complex are listed by Bowden (1983).

Lonicera The cultivars of the honeysuckles are discussed by Bean (1970–1988), Krüssmann (1984–1986), Laar (1988), Schneider (1971), Wright (1983b), and Yeo (1964).

Lophostemon See Australian & South African plants.

Lupinus The cultivars and performance of the lupines are discussed by the Royal Horticultural Society (1931a).

Lythrum The cultivars of *Lythrum* are discussed by Harp (1975).

Magnolia Tresender (1978) lists many cultivars of magnolias, and while dates and hybridizers are generally absent, the descriptions are good. Gardiner (1989) thoroughly discusses magnolia hybrids with photographs. Additional registrations are listed in Bean (1970–1988), Krüssmann (1984–1986), and Vrugtman (1972). Fogg & McDaniel (1975) is a comprehensive list of magnolia cultivars. New cultivars of magnolias are published in *Magnolia Journal.*

Mahonia The cultivars of the grape hollies (and x *Mahoberberis*) are listed by Bean (1970–1988), Brickell (1979), Krüssmann (1984–1986), and Laar (1975).

Malus Bom (1982), den Boer (1959), Grootendorst (1964a), Lombarts (1984), Preston (1944), Van Eseltine (1933, 1934), and Wyman (1943, 1955) include descriptions and introductions of crabapples. (The 1943 edition of Wyman has some information dropped from the 1955 edition, including discarded cultivars and citations to a bibliography.) Jefferson (1970) clarifies the misnaming of crabapple cultivars and provides an extensive bibliography. Bean (1970–1988) and Krüssmann (1984–1986) also list the cultivars of the ornamental crabapples. Lately, crabapple registrations have been carried by the Arnold Arboretum and published in *HortScience* (Spongberg, 1988, 1989).

Melaleuca See Australian & South African plants.

Melia The cultivars of the Persian lilac or Chinaberry (*Melia azedarach* L.) are listed by Mabberly (1984).

Monarda The beebalms are discussed by Oudolf (1993).

Monopyle See Gesneriaceae.

Moussonia See Gesneriaceae.

Myoporum See Australian & South African plants.

Nandina The landscape values of cultivars of heavenly bamboo, *N. domestica* Thunb., are discussed by Raulston (1984).

Narcissus For many years the Royal Horticultural Society printed classified lists of daffodils (1908d, 1910, 1931b, 1938, 1948, 1955, 1958, 1961, 1965, 1969c, 1975), but many of these were not cumulative. The most comprehensive list of cultivars of daffodils is by the Royal Horticultural Society (Kington, 1989a), which updates the 1969 classified list and the classified list and international register of 1975 with supplements 1–14; supplements 15–18 are printed separately (Kington, 1989b, 1990, 1991, 1992). A checklist of daffodils has been provided as a continually updated computer printout by Throckmorton (n.d.), but very old cultivars are listed without a date. The history of cultivar registration of daffodils by the Royal Horticultural Society is documented by Donald (1986). Trehane (1989) also lists cultivars of daffodils. Abridged lists of exhibition daffodils are published by the American Daffodil Society (1977, 1985, 1989). These should be used in conjunction with Bourne (1903), Bowles (1934), Lee (1966), Tompsett (1982), and the "Narcissus editions" of *Herbertia* (vol. 13, 1946) and *Plant Life/Herbertia* (vol. 9, no. 1, 1953).

Nematanthus See Gesneriaceae.

Nepenthes See carnivorous plants.

Nerine See Amaryllidaceae.

Nerium The cultivars of the oleanders are discussed by Anonymous (1958a) and Pagen (1987).

Nigella The cultivars of *Nigella* are listed by Sorvig (1983).

Niphaea See Gesneriaceae.

Nymphaeaceae The most comprehensive list of waterlily cultivars is Swindells (1989b). The cultivars of waterlilies are also treated in Anonymous (1960); Conard (1905); Henkel, Rehnelt, & Dittmann (1907); Kelsey & Dayton (1942); Swindells (1983); and Trehane (1989).

Ophiopogon-Liriope The cultivars of *Ophiopogon* and *Liriope* are discussed by Hume (1961).

Orchidaceae A guide to orchid hybrid (grex) registration is published by Hunt (1986). While lists have been previously published by Sanders, Sanders (1946) is the last cumulative checklist of orchid hybrids; a list of intergeneric taxa is listed in Table II. Later, noncumulative supplements have been published (Sanders & Wreford, 1961; Royal Horticultural Society, 1972, 1980, 1981, 1985c, 1986c). Japan Orchid Growers Association (n.d.) has excellent color photographs of cultivars derived from *Cattleya*. Only Poliakoff (1987) lists *Vanda* cultivars with the percentage of genetic background of each ancestral species. Gilmour, Greatwood, & Hunt (1976) give the names of intergeneric hybrids.

Origanum The cultivars of *Origanum*, the marjorams, are discussed by Tucker & Rollins (1989). Trehane (1989) lists some additional cultivars.

Osmunda See ferns.

Ostrya See *Carpinus*.

Paeonia The cultivars of the peonies are first listed by Coit (1907), later by Beal (1920) and Kelsey & Dayton (1942), and most recently by Jelitto & Schacht (1990) and Trehane (1989). The most comprehensive listing is by Kessenich (1976). These checklists should be supplemented with Wister (1962) for fuller descriptions and a comprehensive bibliography. Haworth-Booth (1963) and Krüssmann (1984–1986) also supply further information on the tree peonies. American peony hybrids are listed by Kessenich (1990). Later introductions have been published in the *American Peony Society Bulletin*.

Pandorea See Australian & South African plants.

Papaver The primary reference on poppy cultivars is Grey-Wilson (1993). The cultivars of the oriental (*P. orientale* L.), Iceland (*P. nudicaule* L.), and other poppies are also listed by Kelsey & Dayton (1942).

Parakohleria See Gesneriaceae.

Parthenocissus The cultivars of Boston ivy, *P. tricuspidata* (Sieb. & Zucc.) Planch, are listed by Laar (1981b, 1992).

Passiflora The cultivars of *Passiflora*, the passion flowers, are thoroughly discussed by Vanderplank (1991).

Pelargonium The most readily available guide to geranium cultivars is Krauss (1955). Bagust (1988) lists the cultivars of the dwarf geraniums. Moore (1955a, 1955b) provides background information on many species and some cultivars. The Australian Geranium Society (1978, 1985) has published the first two sections of a comprehensive *Pelargonium* checklist. Clifford (1970) is also useful.

Penstemon Lindgren (1993) has provided a guide to registration of *Penstemon* cultivars. The most comprehensive guide to the genus is Lindgren & Davenport (1992). The American Penstemon Society (McWilliam, 1973, 1977) also lists registered cultivars.

Pentadenia See Gesneriaceae.

Perennials, herbaceous Grunert (1982), Jelitto & Schacht (1990), Krüssmann, Siebler, & Tangermann (1970), Phillips & Rix (1991), Thomas (1990), and Wehrhahn (1931) rank high among the available reference works on hardy herbaceous plants because of the wealth of information. The perennials registered by the International Registration Authority for Hardy Perennial Plants are listed by Sieber (1990a, 1990b). The cultivars of perennials, based primarily upon British catalogs, are listed by Philip (1992); perennial cultivars based upon northern European sources are listed by Laar & Fortgens (1990). Cultivars of perennials based upon American catalogs are listed by Isaacson (1989). Trehane (1989), emphasizing the cultivars available in the United Kingdom and Northern Europe, provides many dates and names of introducers. Though these latter three publications are excellent, they reinforce some incorrect synonyms by uncritically accepting catalog listings.

Pernettya The cultivars of *Pernettya* are listed by Laar (1969) and Vogel (1969).

Petunia *Petunia* cultivars are listed by Maatsch & Nolting (1968, 1971b) and Nolting & Zimmer (1975b, 1980b, 1984, 1987); the earliest cultivar in these is dated 1947.

Philadelphus The mock orange cultivars are listed by Bean (1970–1988), Dolatowski (1986), Hu (1954–1956), Janaki Ammal (1951), Kapranova & Lukina (1972), Krüssmann (1958c, 1984–1986), Sampson (1965), Schneider (1934), Wright (1980), and Wyman (1965). Recent mock orange cultivars are published by Huttleston (1988).

Phlox Probably the most comprehensive list of phlox culivars is Trehane (1989), but very few dates are provided. Jelitto & Schacht (1990), Kelsey & Dayton (1942), Kharchenko (1975), and Symons-Jeune (1953) also list phlox cultivars.

Phormium The cultivars of New Zealand flax are discussed by Cheek (1979) but more thoroughly by Heenan (1991). New cultivars are listed by Hornback (1994).

Phygelius Cultivars of *Phygelius* are discussed by Coombes (1988). Trehane (1989) also lists cultivars.

Picea See conifers.

Pieris The cultivars of the Japanese andromedas are listed by Bean (1970–1988), Bond (1982), Gelderen (1979), Ingram (1963), Krüssmann (1984–1986), and Wagenknecht (1961b). Spongberg (1988, 1990) records additional registrations.

Pimelea See Australian & South African plants.

Pinus See conifers.

Plagianthus The cultivars of *Plagianthus* are listed by Wright (1983a).

Plant patents The U.S. plant patents and their common names have been assembled by the American Association of Nurserymen (1957, 1958, 1959, 1960, 1961, 1962, 1963, 1967, 1969, 1974, 1981) for plant patents 1-4359. These have been published in one directory (American Association of Nurserymen, 1990) with patents 1-7088. Patents 1-477 are also listed in Kelsey & Dayton (1942).

A review of the U.K. system of Plant Breeders' Rights (PBR) is Goodwin (1986). The patenting of plants under the European Patent Convention (EPC) and The International Union of the Protection of New Varieties of Plants (UPOV) has been reviewed by Byrne (1986), Mast (1986), and Schneider (1986b).

Platanus The cultivars of the plane trees are discussed by Santamour & McArdle (1986).

Platycerium See ferns.

Plectranthus See *Coleus-Plectranthus.*

Plumeria The checklist of the Plumeria Society of America (1988) should be supplemented with the color photographs of Chinn & Criley (1982), Eggenberger & Eggenberger (1988), and Thornton & Thornton (1985). Another checklist of cultivars is Anonymous (1958b).

Poaceae, Cyperaceae, and Juncaceae The best listings of the ornamental grasses, sedges, and rushes are Darke (1990), Hensen & Groendijk-Wilders (1986b), and Trehane (1989). These should be supplemented with Jelitto & Schacht (1990), Loewer (1988), Meyer (1975), Grounds (1979), Ottesen (1989), and Reinhardt et al. (1989). Lawson (1968) lists some cultivars of bamboos.

Populus Checklists of poplar cultivars are Broekhuizen (1977), International Poplar Commission (1971, 1990), Koster (1972), and Roller, Thibault, & Hidahl (1972). Bean (1970–1988) and Krüssmann (1984–1986) provide additional information.

Potentilla Hachmann et al. (1986a), Jelitto & Schacht (1990), Schmalscheidt (1984), and Trehane (1989) list the cultivars of *Potentilla.* The cultivars of the shrubby potentillas are discussed by

Bachtell & Hasselkus (1982), Bean (1970–1988), Brearley (1987), Krüssmann (1984–1986), and Rhodes (1954). The cultivars of *P. fruticosa* L. are listed by Bowden (1957), Laar (1982), Schneider (1967), and Wyman (1968). An additional registration is discussed by Huttleston (1990).

Primula The best listings of cultivars of *Primula* is Trehane (1989). Blasdale (1948), Genders (1962, 1963b), Haysom (1957), Hecker (1971), Hyatt (1989), Jelitto & Schacht (1990), Lyall (1959), Puttock (1957), Swindells (1989a), and Wemyss-Cooke (n.d.) also list many cultivars.

Prostanthera The few cultivars of the mint shrubs are briefly mentioned by Althofer (1978).

Protea See Proteaceae.

Proteaceae Matthews (1983, 1993) and Vogts (1982) provide descriptions and excellent colored illustrations of cultivars of genera of the Proteaceae: *Banksia, Grevillea, Hakea, Leucadendron, Leucospermum, Protea, Serruria,* and *Telopea.* A guide to cultivar registration for Proteaceae is presented by Brits (1988a, c), while a "sample list" of Proteaceae cultivars is presented by Brits (1988b).

Prunus Chadbund (1972) is recommended for cultivars of many flowering cherries. The Oriental flowering cherries are listed by Russell (1934), while the purpleleaf plums are discussed by Jacobson (1992). Only the Sato-zakura group of the Japanese flowering cherries has been published as a separate checklist (Jefferson & Wain, 1984). The bibliography of this checklist, however, gives invaluable references on other ornamental *Prunus.* These should be supplemented with Bom (1982), Grootendorst (1964b), Ingram (1948), Laar (1970b), Miyoshi (1916), Ohwi & Ohta (1973), and Wilson (1916). Other ornamental *Prunus* are listed by Bean (1970–1988), Huttleston (1986, 1990), and Krüssmann (1984–1986).

Pterostyrax The cultivars of the epaulette trees are listed by Fontaine (1970b).

Pulmonaria Cultivars of the lungworts are reviewed by Mathew (1982), Jelitto & Schacht (1990), and Trehane (1989) but generally without introduction dates or names of originators.

Pultenaea See Australian & South African plants.

Pyracantha Cultivars of the fire thorns are listed by Bean (1970–1988), Laar (1966), Hachmann et al. (1986b), Krüssmann (1984–1986), Schmalscheidt (1984), and de Vos (1958).

Pyrus Bean (1970–1988), Bom (1982), and Krüssmann (1984–1986) list ornamental cultivars of pears. The cultivars of the Callery pear (*P. calleryana* Decne.) are discussed by Santamour & McArdle (1983a).

Quercus The cultivars of the oaks are listed by Wyman (1962f) but with few introduction dates and little background. Bean (1970–1988), Bom (1982), Grootendorst (1980b), Krüssmann (1984–1986), and McArdle & Santamour (1985, 1987a, 1987b) thoroughly discuss the cultivars of oaks.

Rhododendron Brickell (1980) provides guidelines for naming *Rhododendron* cultivars. The cultivars of rhododendrons and azaleas are first documented in Fletcher (1958), and this is updated by Royal Horticultural Society (1964, 1969b, 1988e, 1989d, 1989e, 1990c, 1991b, 1992c, 1993b); the registrations from 1962 to 1987 were originally published in *The Rhododendron and Camellia Yearbook* and *Rhododendron with Magnolias and Camellias.* Kraxberger (1980) lists American *Rhododendron* hybrids, many of which were originally published in *Rhododendrons* and *Rhododendron Notebook;* more recently the American

hybrids have been listed in the *Journal of the American Rhododendron Society.* German *Rhododendron* hybrids are discussed by Schmalscheidt (1980). These checklists should be used in conjunction with Bean (1970–1988), Bowers (1960), Bulgin (1986), Cox (1985), Cox & Cox (1988), Galle (1985), Gelderen & Hoey Smith (1992), Greer (1982), Grootendorst (1954, 1967b, 1969b, 1969c, 1979a), Ihei (1984), Krüssmann (1984–1986), Leach (1961), Lee et al. (1965), Livingston & West (1978), Morrison (1953), Phillips & Barber (1967, 1979), Salley & Greer (1986, 1992), and Schneider (1965c, 1966b).

Robinia The cultivars of the locusts are listed by Bean (1970–1988), Gibbs (1929), Grootendorst (1971a), and Krüssmann (1984–1986).

Rosa A proposed guide to rose name registration is Gioia (1986). The most comprehensive recent checklist of cultivars of roses is *Modern Roses 10* (Cairns, 1993), but *Modern Roses 9* (Haring, 1986), *Modern Roses 8* (Meikle, 1980) and *Modern Roses 6* (Allan, 1965) are also important for some rose cultivars. Stock (1984) lists the older and foreign checklists (especially important for heritage roses), such as Boitard (1836), Desportes (1828), Gravereaux (1902), Mansfield (1943), Nietner (1880), Park (1956), Simon & Cochet (1906), and Singer (1885). Jäger (1960) is a reprint of a privately distributed list of 1936. The Royal National Rose Society also publishes selected checklists, most recently in 1976. These should be used in conjunction with Austin (1988), Beales (1985, 1988), Bean (1970–1988), Dickerson (19932), Fagan (1988), Gault & Singe (1971), Griffiths (1984, 1987), Harkness (1991), Krüssmann (1981), Moody (1992), and Phillips & Rix (1988). The *Combined Rose List* (Dobson, 1987, 1988, 1989, 1990, 1991; Dobson & Schneider, 1992) provides continued updating of available roses around the world with cultivar information.

Rosmarinus The origins and essential oils of cultivars of rosemary are listed by Tucker & Maciarello (1986).

Saintpaulia See Gesneriaceae.

Salix Newsholme (1992) provides the most comprehensive descriptions of cultivars of *Salix,* the willows. The cultivars of the weeping willow (*S. babylonica* L.) are discussed by Santamour & McArdle (1988). Broekhuizen & Schneider (1969) discusses the cultivars of the white willow (*S. alba* L.). Anonymous (n.d.), Bean (1970–1988), and Krüssmann (1984–1986) also discuss cultivars of willows.

Sambucus The cultivars of European red elderberry, *S. racemosa* L., are described in German and Latin by Wolf (1923). Bean (1970–1988) and Krüssmann (1984–1986) also discuss cultivars of the elderberries.

Sansevieria The cultivars of the snakeplants are listed by Morgenstern (1979), Stover (1983), and Swinbourne (1979) but without introduction dates and background. Chahinian (1986) thoroughly treats the cultivars of *S. trifasciata.*

Sarracenia See carnivorous plants.

Saxifraga The saxifrages are listed by Köhlein (1984) but without introduction dates or background. Jelitto & Schacht (1990), Trehane (1989), and Webb & Gornall (1989) are comprehensive lists of species and cultivars.

Scabiosa The annual derivatives of *S. atropurpurea* L. are listed by the Royal Horticultural Society (1926c). Perennial cultivars are listed by Jelitto & Schacht (1990).

Scaevola See Australian & South African plants.

Schizostylis The cultivars of the Kaffir lily are listed by Straley (1984).

Schlumbergera See Cactaceae.

Sedum Praeger (1921) and Trehane (1989) list the cultivars of *Sedum*. The history and performance of cultivars of *Sedum* are discussed by Clausen (1978). Hensen & Groendijk-Wilders (1986a) discuss the sedums cultivated in Europe. Some cultivars of sedums are listed by Evans (1983) and Jelitto & Schacht (1990) but without introduction dates or background.

Sempervivum The cultivars of *Sempervivum* (and *Jovibara*) are listed by Mitchell (c. 1973) with some color photographs and good descriptions but without dates or background. Subsequent registrations for *Sempervivum* (and *Jovibara* and *Rosularia*) were published by Mitchell (1982, 1983, 1985). Trehane (1989) also lists the cultivars of the houseleeks.

Serruria See Proteaceae.

Sinningia See Gesneriaceae.

Skimmia The cultivars of *Skimmia* are discussed by Bean (1970–1988), Brown (1980), Laar (1984), and Krüssmann (1984–1986).

Smithiantha See Gesneriaceae.

Solenophora See Gesneriaceae.

Sophora The cultivars of the Japanese pagoda tree, *S. japonica* L., are listed by Bean (1970–1988), Krüssmann (1984–1986), and Schalk (1985).

Sorbus The cultivars of the mountain ashes are discussed by Anonymous (1965), Bean (1970–1988), Krüssmann (1984–1986), Müssell (1971), Wright (1981), and Wyman (1969b). Hensen (1970) discusses the history and performance of cultivars of the *S. latifolia* (Lam.) Pers. complex. Huttleston (1990) records an additional registration.

Spathiphyllum The cultivars of the spathiphyllums are briefly listed by Chase et al. (1984).

Spiraea The cultivars of the spireas are listed by Bean (1970–1988), Grootendorst (1977), and Krüssmann (1984–1986).

Spyridium See Australian & South African plants.

Streptocarpus See Gesneriaceae.

Styrax The cultivars of the snowbells are listed by Fontaine (1970b) and reviewed by Raulston (1992).

Syringa The cultivars of lilacs are thoroughly discussed in Fiala (1988). This should be used in conjunction with Bean (1970–1988), Belorusets (1990), Bilov, Shtanko, & Mikhailov (1974), Gromov (1963), Harding (1933), Kalva (1980, 1988), Kelsey & Dayton (1942), Krüssmann (1984–1986), Luneva, Mikhailov, & Sudakova (1989), McKelvey (1928), Meyer (1952), Rogers (1976), Rubtsov, Zhogoleva, & Lyapunova (1961), Starcs (1928), Vrugtman (1990c, 1991), and Wister (1927, 1942, 1943, 1953a). The latest inventory of Russian cultivars has been translated into English by the International Lilac Society (Rubtsov et al., 1982). Recently the registrations have been published in *HortScience* (Vrugtman, 1988, 1989a, 1989b, 1990a, 1994b), while Vrugtman (1988) and Wister (1963) summarize previous registrations of lilacs.

Tagetes The African, French, and signet marigold cultivars are assembled in checklists by Maatsch & Nolting (1970) and Nolting & Zimmer (1975c, 1981, 1987).

Taxus See conifers.

Telopea See Australian & South African plants and Proteaceae.

Tetratheca See Australian & South African plants.

Thuja See conifers.

Thymus Flannery (1982) records the cultivars of thyme in her thorough Ph.D. thesis.

Tilia Bean (1970–1988), Grootendorst (1970), Krüssmann (1984–1986), and Santamour & McArdle (1985b) discuss the cultivars of the lindens. The cultivars of the lindens are also listed by Muir (1984, 1988) and Wyman (1962e) but with few introduction dates and little background. Huttleston (1989) records additional registrations.

Trees, shrubs, and woody vines (broad-leaved) The best general references on the introduction dates and descriptions of many broad-leaved trees, shrubs, and vines have been Bean (1970–1988) and Krüssmann (1984–1986). Rehder (1940, 1949) also lists many forma epithets; because these are published before the first International Code of Nomenclature for Cultivated Plants in 1952, the forma epithets are now considered cultivar names. Other woody species are listed by Buckley (1980), Commissie voor de samenstelling van de Rassenlijst voor Bosbouwgewassen (1990), Darthuizer Boomkwekerijen B. V. (1987), Dirr (1990), Hillier (1982, 1991), Laar (1989), and Wyman (1963a, 1963b, 1966, 1967, 1969a). The mimeographed Swarthmore Plant Notes (Wister, 1954) are a treasure trove of information on cultivars of woody plants but, unfortunately, are not widely distributed. Registrations of recent woody genera have been published in *HortScience* (Huttleston, 1986, 1988, 1989, 1990; Spongberg, 1988, 1989, 1990), while Huttleston (1986) summarizes previous registrations. Cultivars of street trees are summarized by Gerhold et al. (1989) and Wandell (1989). Some trees and shrubs are also discussed in Hogan (1988) and the journal *Dendroflora* (see the cumulative indices in numbers 20 and 25).

Trichantha See Gesneriaceae.

Trollius The cultivars of the globe flowers are listed by Clausen (1973b) and Hensen (1959). Jelitto & Schacht (1990) and Trehane (1989) also list cultivars.

Tropaeolum A list of cultivars of the common nasturtium is Kelsey & Dayton (1942) but without dates of introduction.

Tsuga See conifers.

Tulipa The cultivars of tulips are first listed by the Royal Horticultural Society (1908c) with significant revisions in 1917, 1929, 1930a, and 1939. Later, in 1948 and 1952, the Royal Horticultural Society published revisions in conjunction with the General Dutch Bulbgrowers Society. Later the Royal General Bulbgrowers' Society (1958, 1960, 1965, 1969) and the Royal General Bulbgrowers' Association (1971, 1976, 1981) published their own lists. The 1958–1965 editions are comprehensive, but the 1969–1981 editions only provided brief descriptions and dates for many tulips, and "historical cultivars" are appended at the rear of the list with no dates or descriptions. Kelsey & Dayton (1924), Kudryavtseva (1987), and Trehane (1989) are also recommended.

Ulmus The cultivars of the elms are listed by Bean (1970–1988), Fontaine (1968), Green (1964), Krüssmann (1984–1986), and Touw (1963). Spongberg (1988, 1991) records additional registrations.

Variegated plants The only work on cultivars of variegated plants is Yokoi

& Hirose (1978). While the text is in Japanese, plant names are in English.

Veronica The history and performance of cultivars of *Veronica* are discussed by Clausen (1971). Jelitto & Schacht (1990) and Trehane (1989) also list the cultivars of *Veronica*.

Viburnum The cultivars of the viburnums are listed by Bean (1970–1988), Egolf (1968), and Krüssmann (1984–1986). Grootendorst (1979b) discusses the cultivars of *Viburnum plicatum*.

Vinca Barnes (1984) and Hensen (1980) discuss the history and performance of the cultivars of *Vinca*. Jelitto & Schacht (1990) and Trehane (1989) also list cultivars.

Viola Jelitto & Schacht (1990) and Trehane (1989) list the cultivars of *Viola*. The history and performance of the cultivars of *Viola cornuta* L., the viola, are discussed by Clausen (1969) and the Royal Horticultural Society (1912, 1913a). The cultivars of violets are treated comprehensively by Coombs (1981). Cultivars of pansies, violas, and violettas are listed by Fuller (1990) without dates or introducers.

Weigela The cultivars of the weigelas are listed by Grootendorst (1968c), Howard (1965), and Schneider (1930). Bean (1970–1988) and Krüssmann (1958a, 1984–1986) also discuss cultivars. Spongberg (1988) records an additional registration.

Wisteria Bowden (1976) and Browse (1984) review the available cultivars of the wisterias but without introduction dates or background. Sprenger (1911) lists the cultivars of *W. sinensis* (Sims) Sweet. Bean (1970–1988), Grootendorst (1968d), and Krüssmann (1984–1986) also discuss cultivars. Huttleston (1988) records an additional registration.

Zelkova The cultivars of the zelkovas are listed by Bean (1970–1988), Dirr (1990), Fontaine (1970c), and Krüssmann (1984–1986).

Zephyranthes The cultivars of the rain lilies are listed by Anonymous (1958e).

Zinnia The modern cultivars of *Zinnia* are listed, with some history, by Sharma & Metcalf (1968).

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The Arnold Arboretum

WINTER • NEWS • 1994–1995

A Literary Trilogy Completed

Robert E. Cook, Director

In the summer of 1840, William Henry Channing became close friends with the transcendentalist Margaret Fuller, disciple of Ralph Waldo Emerson and editor of the transcendental journal, *Dial*. Channing later wrote of one visit with her:

> *It was a radiant and refreshing morning. . . . She proposed a walk in the open air. She led the way to Bussey's wood, her favorite retreat during the past year, where she had thought and read, or talked with intimate friends. We climbed the rocky path, resting a moment or two at every pretty point, till, reaching a moss-cushioned ledge near the summit, she seated herself. For a time she was silent, entranced in delighted communion with the exquisite hue of the sky, seen through interlacing boughs and trembling leaves, and the play of shine and shadow over the wide landscape.*

Thirty-two years later, Bussey's wood became the Arnold Arboretum. It seems that Benjamin Bussey, gentleman farmer of Jamaica Plain, opened his entire estate to the community from the time he acquired the land in the early 1800s until he bequeathed it to Harvard University. In this sense, the Arboretum has been enjoyed by the public for many more years than those since its founding in 1872; the formal establishment of the institution simply recognized what was a widely appreciated but informal practice of excursions to enjoy the beauty of the setting.

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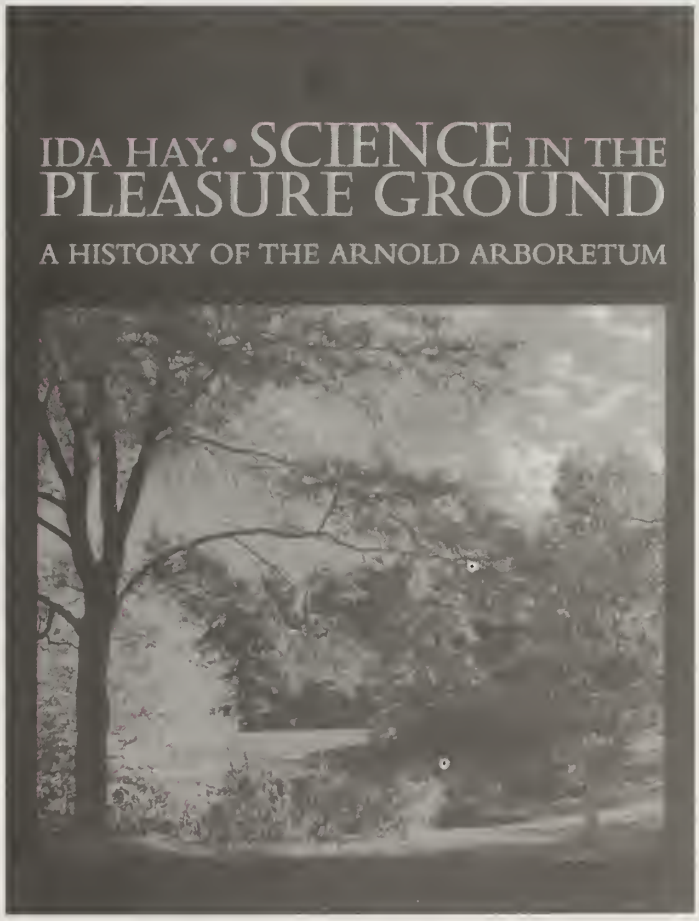

• *from page 1*

The occasion for my discovery of this fact, and of the quote from Channing above, was the recent publication of *Science in the Pleasure Ground*, the third of a trilogy of books by staff members about the scientific and cultural importance of the Arnold Arboretum. *Science in the Pleasure Ground* is skillfully authored by Ida Hay, formerly Curatorial Associate here, and it recounts in rich detail the changes in the Arboretum landscape over time and the history of the institution as expressed in those changes. The earlier two volumes, *A Reunion of Trees* by Steve Spongberg and *New England Natives* by Sheila Connor, spun narratives about the importation of exotic woody plants from the Far East into North America and about economic and horticultural uses of the native species and forests by the several cultures that have occupied the land of New England.

The publication of Ida's book completes a magnificent project, begun over ten years ago and supported by several grants from the National Endowment for the Humanities, that has provided us with a much deeper understanding of the humanistic dimensions of the Arboretum and the critical importance of our living collection of trees to the scientific and cultural developments of the past century. I congratulate all three authors for the high quality of their work, and for the heritage they have rendered accessible to us all.

MHS Honors John H. Alexander III

Bob Howard

The Massachusetts Horticultural Society bestowed the prestigious Jackson Dawson Medal on Arnold Arboretum propagator John H. Alexander III in recognition of his skill and thoroughness in developing and disseminating propagation techniques. Jack, whose career at the Arboretum began in 1976, is well known for his work with the Arboretum's lilac collections and his extensive teaching as well as for his many contributions to the propagation of woody plants. He is seen here at the 1994 Honorary Medals and Awards Ceremony with, on his right, Walter M. Pile, Jr., Chairman of the MHS Board of Trustees, and Executive Director John C. Peterson.

The Jackson Dawson Medal itself honors an Arboretum propagator, master plantsman, and longtime superintendent whose forty-three-year career here began in 1873 as founder Charles S. Sargent's first staff member.

Friends of the Arboretum Gain Free Admission to More Than 100 Arboreta & Botanical Gardens

We are pleased to announce a new benefit for Friends of the Arnold Arboretum: free admission and gift shop discounts at over one-hundred arboreta, botanical gardens, and conservatories across the United States and Canada. Among the many institutions participating in this reciprocal admission program are the Brooklyn Botanic Garden, New York Botanical Garden, the Strybing Arboretum & Botanical Gardens, Missouri Botanical Garden, Denver Botanic Gardens, and the Royal Botanic Gardens in Hamilton, Ontario.

Arboretum members also benefit from the reciprocity arrangement by receiving free admission to the Massachusetts Horticultural Society's annual New England Spring Flower Show, taking place this year March 11 through 19.

All current Arboretum members will receive a new membership card and a complete list of participating institutions. Simply present your Arboretum membership card to take advantage of the new program. If you have questions, or would like to open or renew membership, please contact Lisa Hastings at 524–1718, ext. 145.

Hemlock Hill—The End of an Era

Peter Del Tredici, Assistant Director for Living Collections

Hemlock Hill has always occupied a special place in the history of the Arnold Arboretum as a little piece of wilderness in the heart of the big city. E. H. Wilson summarized the pride felt by Arboretum staff members in his 1925 book, *America's Great Garden,* "Within the hemlock grove reigns the stillness of primeval forest broken only by the babbling of the waters which wash its feet . . . within the limits of no other city can such a grand and inspiring bit of natural forest be found." Research published by Hugh Raup in 1935, however, made it clear that Hemlock Hill was far from being a "primeval" wilderness—it had been heavily lumbered during the late 1700s and early 1800s, and the hemlocks that dominated the landscape when the Arboretum was founded in 1872 had grown up after this logging. Regardless of its origin, however, Hemlock Hill has always had a wild feeling, very different from the rest of the Arboretum.

Unfortunately, a large portion of Hemlock Hill came crashing down during the great hurricane of September 21, 1938, when over 400 trees were blown over, mainly on the southeast slope. These included some of the largest, which dated back to at least 1780. In the two or three years following the hurricane, the hill was replanted with new hemlock seedlings to help stabilize the slopes and to restore the forest, with Donald Wyman bleakly predicting that "It will take the better part of a century before the magnificent grove of Hemlock Hill will again approach its perfection of September 1938."

By the time I started working at the Arboretum in 1979, however, Hemlock Hill had once again achieved the feeling of a wild forest, with a few old specimens interspersed among a mass of much younger trees. Seedling regeneration has always been virtually nonexistent on the hill, a function of the dense shade that hemlocks cast, of their highly absorptive root systems, and of the heavy foot traffic that parades up and down the slopes. Periodic storms and hurricanes since 1938 have continued their relentless program of tree removal, culling specimens with rotten cores or weak roots. This combination of ongoing mortality and lack of seedling recruitment has been a source of concern for the staff for many years, with no obvious solution in sight.

The big nor'easter that struck Boston on December 24, 1994, was yet another reminder that the problem of Hemlock Hill will get worse before it gets better. Two of the biggest trees left on the top of the hill were blown down. Both were there before the Arboretum was founded, and both were totally hollow at the base. One of the trees, approximately 80 centimeters in diameter, had 125 rings at 15 feet above the ground, suggesting an age of at least 150 years. The other tree was over 90 centimeters in diameter and appeared to be of about the same vintage. Along with these two giants, five smaller trees, probably planted after the hurricane of 1938, also came down.

The "hanging wood" of Hemlock Hill photographed in 1905 by T. E. Marr.

From a management point of view Hemlock Hill has always been problematic. On the one hand, it receives minimal maintenance because we like to think of it as a "natural" area. On the other, it is heavily trafficked, and erosion and vandalism (mainly fires) can become very serious problems if not treated or prevented. And just to make matters worse, a new pest, the hemlock woolly adelgid, has recently been found on Arboretum property. This insect, whose arrival had been anticipated for several years, has devastated hemlock populations, both wild and cultivated, throughout the mid-Atlantic region. More recently, the insect has been spotted in hemlock forests throughout southern new England.

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While the pest can be controlled by spraying dormant oil, it is difficult, if not impossible, to control its spread in dense stands of tall trees. Only the Chinese species, *Tsuga chinensis,* appears to be fully resistant to damage from the adelgid.

These factors have led the Living Collections Committee to revise its management program for Hemlock Hill. The first change has been to allow as much organic matter as possible to remain on the hill in an attempt to encourage natural seedling regeneration. This translates into a policy that calls for chipping up the branches of the tree (thereby minimizing the fire hazard) and leaving the trunks where they fall to act as "nurse" logs. The second step will be to plant open areas with *Tsuga chinensis* in an effort to head off total devastation by the adelgid. This species is rarely cultivated in North America. While we have a few old specimens at the Arnold Arboretum,we have begun assembling specimens from various parts of its natural range. With a little luck they will be ready to plant out in three or four years.

Mercer Fellow

Lisa Curran has been granted a two-year Mercer Fellowship to work with the Arboretum's Indonesian Biodiversity Collections project. Since receiving her undergraduate degree from Harvard University in 1984, Lisa has been investigating the ecology, use, and management of tropical forests in Kalimantan (Indonesian Borneo). She assisted the Indonesian government with biodiversity surveys and research programs in two forest reserves that were later upgraded to national park status. She also conducted a number of field courses in tropical botany while in Kalimantan, and on several occasions served as a forestry consultant to the government of Indonesia. In field surveys and investigations of over seventy Kalimantan timber concessions and affiliated wood-based industries, she evaluated the ecological, economic, and social impact of government policies and timber company practices on forest resources and local village communities.

In July 1994, Lisa received her Ph.D. from the Department of Ecology and Evolutionary Biology at Princeton University with a thesis entitled "The ecology and evolution of mast-fruiting in Bornean Dipterocarpaceae: A general ectomycorrhizal theory." It was based on her eight-year study of the reproductive biology and regeneration of the prominent family of Southeast Asian commercial timber trees and their insect and vertebrate seed predators. Her current research interests center on the impact of forest policies and practices on biodiversity in tropical canopy trees and the effects of seedling recruitment fluctuations on the maintenance of species diversity.

Karen Madsen

Lichens: Fine Details of the Natural Landscape

Lichens—actually symbiotic associations between fungi and algae or cynobacteria—are among the most ubiquitous forms of life across the globe. From February 21 to May 15, the Arboretum will present a photographic exhibit that explores the natural history of this fascinating group of organisms. "Lichens: Fine Details of the Natural Landscape" will be available for viewing in the Arboretum's Hunnewell Building at 125 Arborway in Jamaica Plain.

The Arboretum will also offer a free lecture, "Lichens, a Special Biological Interaction," by Donald H. Pfister, Asa Gray Professor of Systematic Botany, Harvard University. The lecture will be held on Tuesday, April 4, at 7:30 pm in the Hunnewell Building. To register, please call 617/524–1718 ext.162.

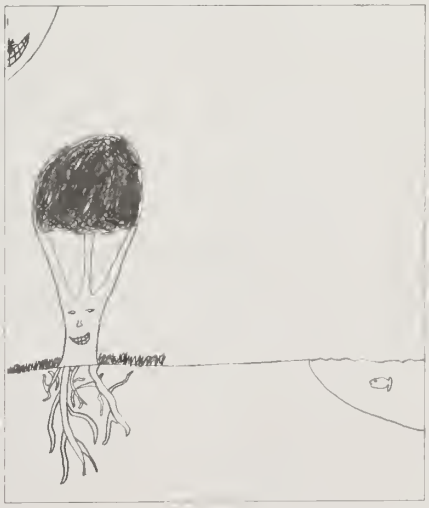
What Is Landscape? . . . "A piece of land which is old or has nature" . . . "How the land works" . . . "What you can see through your eyes"

Richard Schulhof, Assistant Director for Education and Public Affairs

Over one hundred 6th-grade students at the Doherty Middle School in Andover ventured a response to the key question addressed in the new Arboretum program, Junior Parkmakers: What is landscape? Supported by grants from the National Endowment for the Arts and the National Park Foundation, the Arboretum and the Olmsted National Historic Site are working together to introduce Boston-area children to the concepts of landscape and landscape history. Development of the program began this past fall with focus groups comprised of local teachers and museum educators.

Mary Chmielecki, a teacher at the Doherty School, tested the power of the word *landscape* with her students. She asked them to define their idea of it in one sentence and then to draw it. Their responses underscored the word's ability to evoke a wide range of personal interpretations. Although the highly varied responses made categorization difficult, roughly 25 percent thought of it as a verb ("making the lands look better"), 30 percent interpreted it as a natural or aesthetically pleasing place ("beautiful, fresh-looking scenery"), and 40 percent as a quantity or unit of land ("land for about a mile"). While all of the participants included trees in their drawings, a few children described landscape as construction sites or areas for dumping and included bulldozers or abandoned cars in their drawings.

These descriptions provide an extremely useful snapshot of the diverse perspectives that participants will bring to the program. We extend our many thanks to Ms. Chmielecki and her students for their creative and enlightening contribution. Junior Parkmakers will be field-tested later this year; it will include classroom activities and visits to the Arboretum designed to connect kids with Boston's rich heritage of historic and designed landscapes.



Understanding Urban Trees: Getting to the Root of the Matter

Kim E. Tripp, Putnam Fellow

Trees in cities have much to contend with. Restricted rooting areas, high winds, severe temperature fluctuations, extremes of drought and flooding, compacted or contaminated soils with high concentrations of salt, and repeated mechanical damage affect the tree's ability to maintain actively growing and functional roots. Moreover, they must cope with these extreme conditions immediately following one of the most stressful perturbations that managed woody plants are subjected to, namely, transplanting. No tree in nature is subjected to this kind of disturbance—seedling trees may be chewed on, crushed by fallen limbs, stepped on, or attacked by disease, but they are not uprooted to be replanted miles away in an alien, stressful environment.

In modern horticulture, tree seed, cuttings, and young trees are brought from a range of climates around the world to nurseries where they are grown with nearly optimal fertilization and irrigation. In field-production nurseries, plants may lose as much as eighty to ninety percent of their root systems when they are dug for shipping to a new site. The advent of the mechanical tree spade has made it virtually impossible to transplant large trees without losing most of their mass of fine roots—those roots most important for water and nutrient uptake in support of the whole organism. This means that, once replanted, trees must be able to regrow significant masses of fine roots as quickly as possible in order to survive. That ability, which varies widely among species and even among cultivars and hybrids with shared parentage, becomes a dominant factor in determining survival.

My research project at the Arnold Arboretum addresses this issue in two ways: Which ornamental woody plants in the diverse living collections of the Arnold Arboretum have over time demonstrated good potential for surviving in stressful managed environments? And among these successful plants, are there similarities in root growth patterns that permit us to generalize about what leads to successful root development and long-term survival in stressful environments, and thereby better predict which trees might thrive in such sites?

Kim Tripp

A successfully rooted cutting of *Alnus japonica,* the Japanese alder.

The first question is readily answered by straightforward evaluation of the collections with reference to the invaluable records that detail source, age, and prior management. Over the past year I have had the great pleasure of discovering many interesting and unusual ornamental woody plants that show great potential for urban use. I am currently working to document optimal propagation techniques for these plants and to promote them for commercial production.

I have addressed the second question by investigating how woody plants invest in root growth relative to shoot growth. My previous work and that of others has uncovered a clear coincidence between success in environments hostile to root growth and allocation of significantly greater proportion of overall growth to roots than to other parts of the plant. This pattern holds up even among closely related plants. For example, if we grow two closely related hollies from rooted cuttings—one that performs well in stressful root environments and one that doesn't—we find that the successful holly consistently allocates much more of its growth to its root system than to its aboveground parts. This preference for investment in root growth versus shoot growth remains consistent throughout early development from rooted cuttings, through the container-grown stage, and on through two seasons in the field.

These findings help us understand urban tree growth and development. They may also allow us to develop relatively rapid screens for successful urban plants simply by rooting cuttings and growing seedlings of untried species and cultivars. This two-fold project is a unique opportunity for me to take advantage of the great diversity and excellent documentation of the living collections at the Arnold Arboretum in service to both practical and theoretical horticulture.

Spring and summer are prime seasons for gardeners, and the Arboretum offers many short courses in horticulture and botany. Begin your gardening career with introductory courses, or improve your skills with advanced courses in horticultural techniques and plant study. A selection is shown below.

For a complete catalogue of programs and events at the Arboretum, call (617) 524-1718, ext. 162. Please note that course fees printed in **boldface** are for Arboretum members.

APRIL

HOR 327 Starting and Running a Home Nursery

John H. Alexander III, Chief Plant Propagator, Arnold Arboretum

Are you growing so many plants that you sometimes feel you might as well be running a nursery? Would you like to sell some of the plants you produce? In this workshop for the serious amateur, your questions will be answered. Is a greenhouse required? Where should you buy supplies, stock, liners, equipment? What are the legal aspects of starting a nursery? What about irrigation? How should you inform customers of your offerings? Can you manage without a catalog? Extensive handouts are included. Bring a lunch.

Fee: $117, $134

2 Saturdays, April 1, 8/ 9:00 am–3:30 pm (Dana Greenhouse)

HOR 195 Successful Tree and Shrub Planting

James F. Martin, Professional Arborist and Horticultural Instructor

Establishing young trees and shrubs is an important spring gardening task for the homeowner and garden professional. Learn planting techniques that will give a new tree or shrub the best chance of survival. This course will cover decisions to be made at the time of purchase, transportation, planting hole preparation, settling the plant in, finishing touches, and maintenance. The course is appropriate for both novice and experienced gardeners as well as for horticultural professionals. Please dress for the outdoors.

Fee: $40.00, $46.00

2 Saturdays, April 1, 8/ 9:30–noon (Case Estates)

HOR 172 Bamboos in the Home Landscape

Chris DeRosa, Owner, New England Bamboo Company

Bamboos add movement, grace, and elegant form to your garden. Beautiful as they are, gardeners know that some bamboos can become invasive garden problems. Join Chris DeRosa, a recognized bamboo expert, to learn about the variety of hardy bamboos suitable for New England gardens, their culture and uses in the landscape.

Fee: $12, $15

Thursday, April 6/ 7:00–8:30 pm (Case Estates)

HOR 110 Fundamentals of Gardening

Laura Eisener, Landscape Designer

Whether you are a novice starting your first garden or an old hand looking for a firmer foundation, this practical course will satisfy your quest for basic gardening information. In four sessions this course will cover basic techniques of gardening, including site analysis and soil preparation, irrigation, drainage, watering, plant selection, and horticultural requirements of plants. Weather permitting, there will be some hands-on work at the site, in addition to lectures and demonstrations.

Fee: $85, $100

4 Fridays, April 7, 14, 21, 28/ 10:00 am–12:30 pm (Case Estates)

MAY

Identification of Temperate Woody Plants

Arnold Arboretum Staff Members Gary Koller, Stephen Spongberg, Chris Strand, and Kim Tripp. Marcia Mitchell, Course Coordinator

This introductory course, taught by Arnold Arboretum staff members, is designed to provide a solid foundation for the identification of woody plants hardy in New England. Students may begin the two-semester curriculum in either fall or spring.

HOR 101 Identification of Temperate Woody Plants (Spring) includes deciduous shrubs, small flowering trees, and the spring characteristics of larger landscape trees and conifers.

HOR 102 Identification of Temperate Woody Plants (Fall) includes the autumn aspect of these genera and species, and presents conifers, broadleaf evergreens, and other plants whose key characteristics are best observed in the fall and winter.

Fee: $125, $150

7 Tuesdays, May 2, 9, 16, 23, 30, June 6, 13/ 10:00–noon (Dana Greenhouse)

New Staff at the Arboretum

Karen Madsen

Carol David brings five years of librarianship to her position as the new Library Assistant at the Horticultural Library. Her responsibilities include reference services, acquisitions, and technical services. At present ninety percent of the horticultural collection is not on HOLLIS, Harvard's online catalog. Her immediate concern will be to continue to update online access in order to accelerate research efforts. Carol is a graduate student of library science at Simmons College and comes to us from the Lucien Howe Library of Ophthalmology and Otolaryngology at Massachusetts Eye and Ear Infirmary.

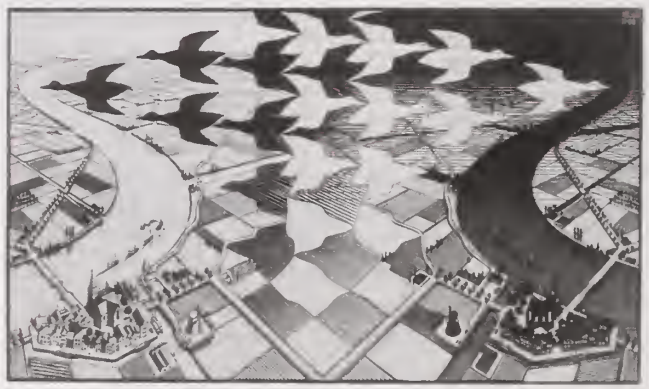
Lisa M. Hastings recently joined the Arboretum as Development Officer. Her responsibilities include managing the Arboretum's membership and annual appeal efforts and planning and organizing events related to the Arboretum's participation in the University's Capital Campaign. She joins us from Worcester Polytechnic Institute in Worcester where, as Director of Young Alumni Programs,

Karen Madsen

she was responsible for all aspects of fundraising and program management for WPI's young alumni constituency of seven thousand. Lisa is a longtime volunteer at the Fisher Museum of Forestry at the Harvard Forest in Petersham and at the Worcester County Horticultural Society.

1995 Winter Lecture Series: *The Nature of Cities*

This winter marks the third year of collaboration among the Arnold Arboretum, Olmsted National Historic Site, the Harvard Graduate School of Design, and a number of other sponsors to present a lecture series exploring our changing relationship with the American landscape and natural environment. This year's series will discuss the future of urban open space and examine the ongoing debate about how "nature" can best be shaped and managed as an integral part of the American city.



Maurits C. Escher, *Night and Day*, Philadelphia Museum of Art. Given by Mrs. Herbert C. Morris

All lectures are free and begin at 6:30 pm in the Piper Auditorium of the Harvard Graduate School of Design at 48 Quincy Street in Cambridge. The Arboretum extends its thanks to the Massachusetts Foundation for the Humanities for its support of the series.

February 9: The Future of the Garden in America—Beyond the Wilderness and the Lawn
Michael Pollan, Author of *Second Nature*

February 23: A Manifesto for the Charles River
Sam Bass Warner, Jr., Urban Historian

March 9: Regrounding Nature in the New City
Catherine M. Howett, Professor, School of Environmental Design, University of Georgia

March 23: Imagining the New Urban Park
Diana Balmori, Principal, Balmori Associates

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Acer sanguineum seige